PowerBook Technology & Troubleshooting

Student Guide

Version 1.0

Apple Computer, Inc.

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Course Introduction

Overview

Welcome to the *PowerBook Technology and Troubleshooting* course. This self-study, hands-on course was designed to give you the basic skills that you need to troubleshoot and repair Apple PowerBook computers. “Self-study” means that you can work at your own site and at your own speed; “hands-on” means that you learn the skills in this course by practicing on actual Apple equipment.

The *PowerBook Technology and Troubleshooting* course consists of the Student Guide on the CD.

Prerequisites to This Course

Before starting this course, you need to complete the *Macintosh Service and Tools* and *Macintosh Operating System Troubleshooting* courses.

Training Environment

The advantage of self-study training is that it can be completed at your own site. A challenge, however, is that it may be more difficult to dedicate the time or equipment to complete the training.

For this training to be most effective, you need to have:

- Dedicated time to complete the training.
- Access to equipment to complete the hands-on exercises.
- Access to a certified PowerBook computer technician or another technician who is familiar with servicing PowerBook computers.

Additional Information

Additional information about Apple's service training, the certification exam program, curriculum paths, and course descriptions is available on the Worldwide Web (http://service.info.apple.com/) in the Training area. You must have your Service Source Online name and password ready. You can also call Service Provider Support at 1-800-919-2775 in the United States or 1-905-513-4279 in Canada.

PowerBook Service Certification Exam

To become certified to repair Apple PowerBook computers, you need to pass the PowerBook Service Certification Exam. This exam is a computer-based test that is offered at Authorized Prometric Testing Centers.

Completing this course, including all the exercises, should prepare you for much of the content found in the exam. You will be expected to use Apple Service reference materials during the test to help you troubleshoot scenarios not directly addressed in the PowerBook Training Kit. Refer to “PowerBook Exam Skill Assessment Guide” to help you understand the scope of the test, the topics covered, and how the questions are structured.

The “PowerBook Exam Skill Assessment Guide” is also available on Service Source Online (http://service.info.apple.com/) in the Training: Certification: Preparing for the certification exams area.

Materials Needed to Prepare for the Exam

To prepare for the PowerBook Service Certification Exam, you need the following items:

- PowerBook Service Training Kit (Part Number 011-8002)

  This kit includes the following courses: *PowerBook Technology and Troubleshooting, PowerBook 100 Series Service Training Course, PowerBook 200 Series Service Training Course*, and *PowerBook 500 Series Service Training Course.*
- PowerBook Exam Skill Assessment Guide

How to Obtain Materials

To order the PowerBook Service Training Kit or the Macintosh Service Training Kit (Part Number 011-8001) which includes the *Macintosh Service & Tools* and *Macintosh Operating System Troubleshooting* courses, refer to the Service Price Pages.

How to Study

To prepare for the exam,

1. Review “PowerBook Exam Skill Assessment Guide” to see what objectives are covered on the exam.
2. Complete the courses in the PowerBook Service Training Kit.

PowerBook Exam Skill Assessment Guide

The Apple PowerBook Service Certification Exam is a computer-based test offered at Authorized Prometric Testing Centers. The exam lasts one hour and is composed of multiple-choice and true-false items that cover the objectives listed in “Exam Content Areas.”

Sample Questions

Here are two sample items (the answers are on the next page):

1. Which PowerBook family of computers uses an On / Off PCB?
   a. PowerBook 100 Series
   b. PowerBook 200 Series
   c. PowerBook 500 Series
   d. PowerBook 5300 Series
2. When you choose the PowerBook control panel option “Allow processor cycling,” how does it affect the PowerBook?
   a. The processor operates at a constantly higher speed.
   b. The processor operates at a constantly lower speed.
   c. The processor speeds up when the computer has been idle for a few seconds.
   d. The processor slows down when the computer has been idle for a few seconds.

Note — Compare your responses to the correct answers on the next page.

Answers to sample questions: 1 - B; 2 - D.

Exam Content Areas

To prepare for the Apple PowerBook Service Certification Exam, read through the exam objectives below and determine whether you can meet each objective or whether there are areas you need to study prior to taking the exam. Note that you will have access to *Service Source* CD and Apple Service Guides during the test. However, over-reliance on these resources will inhibit your ability to finish the exam within the allotted time. You will not have time to look up every answer.

1. Locate and identify the function and use of power management features. During the exam, you will be expected to do the following:
    - Identify and indicate how to use the three power modes: awake, sleep, and shutdown.
    - From pictures, locate control strip modules and controls.
    - Identify the function of control strip modules and controls.
    - From pictures, locate PowerBook control panel features, and identify their functions.
    - Identify how to use the PowerBook control panel to manage power consumption.
    - Identify specific low-power warning messages and symptoms, and indicate the appropriate action to take in response to them.
2. Identify cautions to be aware of and procedures to use to recharge batteries. During the exam, you will be expected to do the following:
    - Identify proper disposal procedures and safe recharging and handling procedures for PowerBook batteries.
    - Identify procedures for recharging the main battery with and without using a battery recharger.
    - From pictures, identify proper installation and use of a battery recharger.
    - Identify procedures for recharging and extending the life of specific battery types.

3. Locate and identify the function of both common and unique controls, buttons, switches, and other external hardware features. During the exam, you will be expected to do the following:
    - Locate and identify the function of controls, buttons, ports, and switches common to most PowerBook computers (for example, the power switch).
    - Locate and identify the function of controls, buttons, ports, and switches unique to some PowerBook computers (for example, the storage switch of the PowerBook 100).
4. Locate major components and identify their functions. During the exam, you will be expected to do the following:
    - Determine the modules and components used in specific PowerBook families and the module locations of specific components. (For instance, which PowerBook families use a cousin card? On what module is VRAM located in a specific PowerBook model?)
    - From pictures, locate modules and components used in specific families of PowerBook computers.
    - Identify the functions of major modules and components of PowerBook computers.
5. Identify troubleshooting procedures and diagnostic resources. During the exam, you will be expected to do the following:
    - Given a problem description and using knowledge of major PowerBook modules and their functions, identify the most likely cause of the problem.
    - Given a problem description and using Service Source, identify the next troubleshooting step to take to resolve the problem.
    - Identify the function and use of PowerBook troubleshooting diagnostic resources including Apple Service Guides, Service Source, and MacTest Pro.
6. Locate repair information and procedures, identify cautions specific to repairing PowerBook computers, and identify the function of special tools. During the exam, you will be expected to do the following:
    - Identify cautions specific to repairing PowerBook computers.
    - Using reference resources such as Apple Service Guides and Service Source, identify the sequence of procedures used to repair a specific problem (for example, replacing a faulty display).
    - Identify the function and use of special tools used to repair PowerBook computers.

Student Guide

Overview

The Student Guide provides an overview of Apple's PowerBook technology and troubleshooting procedures and exercises in which you practice what you have learned.

The following modules are found in the this guide:

- PowerBook Basics and Usage Skills
- PowerBook Theory of Operation
- Modem Technology and Modem Types
- Power Management
- Troubleshooting PowerBook Computers
- Repairing PowerBook Computers

Module Layout

Each module in this course contains the following information:

Objectives

Lists the skills you will learn in the module.

Materials

Identifies the reference materials, computer equipment and configurations, and other tools you need to complete the module.

Time

Estimates how much time it takes to complete the entire module, including exercises.

Skills Checklist

Lists the skills you should be able to demonstrate after you complete the module.

Information/ Content Section

Provides the information you need to know before you complete the written and hands-on exercises.

Exercises and Tests

Written and hands-on exercises and practice tests help you check your understanding and give you practice with actual tools and equipment.

Warning — To avoid serious personal injury or damage to equipment, it is critical that you adhere to all “Warning” and “Caution” notes in the course materials.

PowerBook Basics and Usage Skills 1

To tell whether a PowerBook computer is functioning correctly, you have to know how to use one. Because the best way to learn is hands-on, this module asks you to find a PowerBook computer and to learn the basic skills a user must have to use it correctly. To make sure you have the references you need, we have provided copies of the User's Guides for most PowerBook computers on the CD that contains this course.

What You Will Learn

When you finish this module, you will be able to set up and perform basic user operations on a PowerBook computer correctly, without damaging the equipment.

The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module. Note that specific skills concerning the power management control panels and control strip are taught in Module 4, Power Management Skills.

Required Materials and Equipment

This module requires the following materials and equipment:

- PowerBook computer (PowerBook 190, 1400, 2400, 3400, 5300, G3, or G3 Series recommended—or you can use two IR-capable PowerBook computers)
- User's Guide for the PowerBook computer you are using (pdf files of most PowerBook User's Guides are on the CD that contains this course)
- Compatible expansion bay device
- Compatible PC card (optional)

- External monitor with power cable, monitor cable, and PowerBook monitor adapter (see the User's Guide for your PowerBook computer for details)
- Desktop Macintosh computer system, with power cable.
- SCSI system cable for desktop Macintosh
- PowerBook SCSI Disk Adapter cable (and extender cable, if needed)
- SCSI terminator
- Apple serial printer (if available) or other Macintosh-compatible serial printer, with serial cable, power cable, and appropriate printer driver.

Time to Complete This Module

This module should take approximately 30 minutes to complete, once you have gathered the required materials.

Skills Checklist

If you think you already possess the following skills, go directly to the module test. If you pass the test, congratulations! Go on to the next module. If you don't pass the test, complete this module before you proceed.

______ • Identify the two types of PowerBook computers, notebook and subnotebook (Duo).

______ • Remove/insert main battery.

______ • Remove/insert expansion bay modules.

______ • Attach/remove power adapter.

______ • Start up a PowerBook computer.

______ • Put the computer to sleep, and wake it up.

______ • Adjust screen brightness and contrast (if applicable).

______ • Use a PowerBook trackpad.

______ • Use the Trackpad control panel.

______ • (Optional) Insert/eject PC card.

______ • Set up an external monitor in video mirroring mode and in dual screen mode.

______ • Define SCSI disk mode.

______ • Set up and run a PowerBook in SCSI disk mode.

______ • Shut down a PowerBook computer (using at least two methods).

______ • Attach and use a serial printer.

______ • (Optional) Use Apple IR Exchange to send and receive files through the IR window.

______ • (Optional) Use the embedded numeric keypad (PB G3 Series only).

Using a PowerBook Computer

Using a PowerBook computer will give you the experience you need to understand what users are talking about when they describe a problem with their computer. The tasks you should perform are given below, in Exercise 1. For step-by-step instructions in performing the tasks, you will rely on the User's Guide for the PowerBook model you are using. All available PowerBook User's Guides are on the CD-ROM for this course. These guides are PDF (Portable Document Format) files.

It's a good idea to consult the User's Guide before using—or servicing—a PowerBook computer, because there are significant differences in features among the PowerBook models.

For example, to start up a PowerBook 5300, you press the power key on the keyboard. On many earlier models, such as the PowerBook 140, there is no power key—you have to press a power button on the back of the computer. And on the PowerBook 100, there is neither a power key nor a power button—there is a storage switch that you must put in the up position, and then you press any key on the keyboard (except Caps Lock) to start up the computer. You can learn all this by trial and error, but a glance at the User's Guide can save you time, especially with early models.

Here's another example: In many PowerBook computers, CD-ROM drives, floppy drives, and batteries can be “hot-swapped” (removed and inserted while the computer is powered up and operating). However, some PowerBook models, such as the 1400 series, require the computer to be shut down or in sleep mode before you remove or insert an expansion bay module. Assuming that you can “hot swap” could cause you to damage a module or computer. (See Table 1, for a partial listing of important differences among current and past PowerBook models.)

So the User's Guide can be an important resource when you're servicing a new PowerBook model for the first time.

Table 1: PowerBook Models and Features

Feature	PowerBook Model	How Implemented
Power on	100	With storage switch in up position, press any key except Caps Lock.
	140, 145, 145B, 150, 160, 165c, 170, 180, 180c	Press power button on back panel of computer.
	200 series, 500 series, 190 series, 1400 series, 2300c, 2400c, 3400 series, 5300 series, G3	Press power key on keyboard.
	G3 series	Press power key above keyboard.
Shut down	100	Choose Shut down from Special menu. If storing for longer than a week, put storage switch into down position.
	140, 145, 145B, 150, 160, 165c, 170, 180, 180c	Choose Shut down from Special menu
	All PowerBook models with power key on keyboard	Choose Shut down from Special menu, or hold power key down for 2 seconds, then click Shut Down from dialog box.
Expansion bay module swapping	1400	Computer must be off or in sleep mode before module can be inserted or removed. (In sleep mode, module must be empty of disks before being removed.)
	190, 3400, 5300, G3, G3 Series	Hot-swapping allowed—computer can be on when module is removed or inserted. CAUTION: Drive to be swapped must be empty of disks when removed.
SCSI disk mode / HD target mode	140, 145, 145B, 150, 170	Not available.
	200 series, 2300c	Use the Apple HDI-30 Disk Adapter cable in conjunction with the Duo MiniDock to enable the Duo to be used in SCSI Disk Mode
	All other PowerBook models up to May, 1998	Use Apple HDI-30 Disk Adapter (M2539LL/A).

The Two Types of PowerBook Computers

There are two basic types of PowerBook computer: notebooks and subnotebooks. The PowerBook 200 and 2000 series are subnotebook computers. All other PowerBook computers are notebook computers.

Subnotebooks are lighter in weight than notebook computers because they are designed without internal floppy drives and expansion bays. The PowerBook Duo series, which includes all the PowerBook 200 series and the PowerBook Duo 2300c, was designed to be used with a separate docking device called a Duo Dock or MiniDock. The Duo Dock or MiniDock contains the I/O ports normally found on notebook-size PowerBook computers. These ports are not available on the Duo itself.

PowerBook 2400 series subnotebook computers are designed without docking devices. They contain the full complement of I/O ports, plus a connector for an external floppy drive. However, they lack an expansion bay.

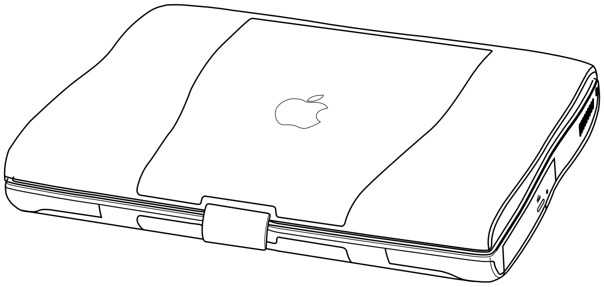
To get the most out of the exercises in this module, use a recently released notebook-class PowerBook computer, not a subnotebook computer.

PowerBook G3 Series and PowerBook G3 Computers

Macintosh PowerBook G3 computers are not the same as *Macintosh PowerBook G3 Series* computers. Though the names are similar, there are significant differences. For example, the PowerBook G3 Series keyboard includes a Function key (*fn*) which is absent on the PowerBook G3 keyboard. The presence of the *fn* key is one way to tell a PowerBook G3 Series computer from the original PowerBook G3 computer.

Another way to visually identify which type of computer you have is to inspect the display case (see Figure 1-1). The original PowerBook G3 has a small, six-color Apple logo on the display case. The newer PowerBook G3 Series computers have a large white Apple logo.

Powerbook G3 Series



Powerbook G3

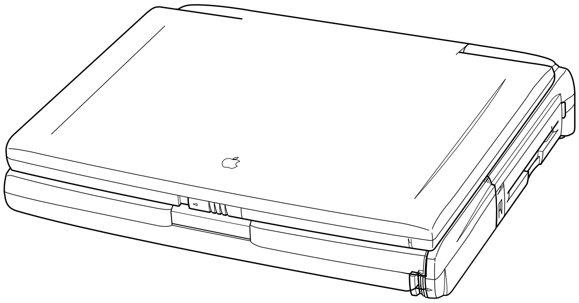


Figure 1-1: PowerBook G3 and G3 Series Computers

Exercise 1: Basic PowerBook User Skills

When you are ready to practice, locate the User's Guide for the PowerBook computer you are using. (Adobe Acrobat versions of most PowerBook User's Guides are on the CD that contains this course. If you do not have a printed User's Guide, you can either display the Acrobat file on the desktop Macintosh you are using or print the guide from the pdf file.)

For each of the following steps, find and follow the instructions in the User's Guide before performing the task:

1. With the computer off, remove and reinsert the main battery.
2. With the computer off, remove and reinsert the expansion bay device, if present.
3. Attach the AC adapter to a power source, and then to the computer.

Warning — Attach the AC adapter to the power source BEFORE you attach the adapter to the PowerBook computer. Attaching the adapter to the computer first could corrupt the power manager software.

4. Start up the PowerBook computer.
5. Put the computer into sleep mode using all methods described in the User's Guide. (Some PowerBook models have three or more methods!)
6. Wake the computer from sleep.
7. Adjust the screen brightness.
8. Adjust the screen contrast, if there is a contrast control. (Not all models have a contrast control.)
9. Practice moving the cursor with the trackpad (on earlier models, the trackball).
10. Use the control panel named Trackpad (or Trackball, or Mouse, depending on the Mac OS version installed) to adjust the tracking speed and double-click speed of the trackpad or trackball.
11. Insert the PC card (if this PowerBook computer supports PC cards).
12. Eject the PC card using at least two methods (one using hardware switches, one using software).

13. Attach a serial printer (Apple brand, if available) to the modem / printer port and, if necessary, install the printer software (printer driver).

    Refer to the appropriate PowerBook User's Guide for directions on how to set AppleTalk when you connect a printer.

14. Use the Chooser to set up the printer for use.

    If the Chooser shows two ports available for the printer (modem port and printer port), choose the modem port.

15. Use SimpleText to create a sample file, and print it on the printer.

16. Attach an external monitor to the PowerBook in video mirroring mode (if available on this model).

17. Check the User's Guide to see whether *dual-screen* mode is available for this PowerBook computer. If it is available, use the appropriate control panel to activate dual screen mode. (You may need to restart the computer — see the User's Guide or Mac OS Help (Apple Guide) for instructions.)

18. Shut down the system and remove the external monitor. Then attach the PowerBook to the desktop Macintosh in SCSI (Small Computer System Interface) disk mode. On some PowerBook computers, SCSI disk mode is called *HD target mode* or *target disk mode.* These PowerBook models have an integrated drive electronics (IDE) hard drive, not a SCSI hard drive. Although the terminology is different, the function is the same.

    Then perform the following actions:

    a. Open files or programs on the PowerBook hard drive.

    b. Copy files to and from the PowerBook computer.

Note — The hard disk in PowerBook G3 Series computers uses a new file format called Mac OS Extended format (or HFS Plus). Earlier PowerBook models upgraded to Mac OS 8.1 may also use HFS Plus format, if the user has reformatted the hard disk. To use an HFS-Plus-formatted PowerBook computer in SCSI disk mode, the computer to which the PowerBook is connected must be running Mac OS 8.1 or later. If the computer has a Mac OS version earlier than 8.1, you will not be able to see the files on the PowerBook computer's hard disk.

19. Shut down the PowerBook and the Macintosh correctly, and disconnect all SCSI cables.

20. Refer to the User's Guide to identify one or more additional ways to shut down the PowerBook computer. Practice using those methods.

21. (Optional) If you have two IR-capable PowerBook computers, use the Apple IR File Exchange program to exchange files between them. (Refer to the User's Guide or the Apple Guide help system for instructions.)

22. (Optional) If you are using one of the PowerBook G3 Series computers, you will notice that some keys bear additional markings in small brown type. For example, the F5 key carries the additional marking “num lock.”

    These additional markings indicate the functions that these keys perform when the fn key is pressed or when the computer is in keypad (Num Lock) mode. In keypad mode, the only active keys on the keyboard are those with brown markings, and they can be used only for the functions indicated in brown type.

    To put the computer into keypad mode,

    a. Hold down the Function (*fn*) key and press the F5 key. The light to the left of the F5 key (see Figure 1-2) should come on, indicating that the computer is now in keypad (Num Lock) mode. If the light does not come on, try again.

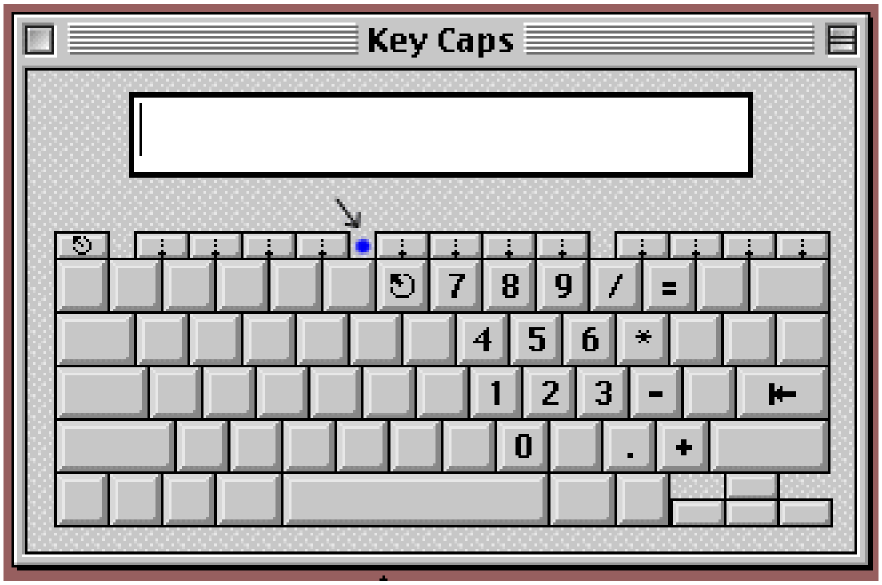


Figure 1-2: PowerBook G3 Series Keypad (Num Lock) Mode

In keypad mode, the only active keys are those shown in Figure 1-2 and the following keys:

Arrow keys
Function key
Control key
Option key
Command key
Spacebar
Shift key
Tab key
Caps Lock key
Escape key
F1 - F12 keys

All other keys are disabled until you press the Function-F5 key combination again to return the keyboard back to its normal configuration. Note that when the keyboard is in keypad mode, you can access all of the normal keys by pressing the Function key and the key. While the Function key is pressed normal keys are accessible.

b. Use the trackpad to pull down the Apple menu and select the Calculator.

c. Using the embedded numeric keys, add 2 + 4 by pressing the following keys (referred to by their normal functions in the left column of the table below, by their Num Lock functions in the right column):

Normal Markings	Num Lock Marking
k	2
/	+
u	4
-	=

The result shown on the calculator should be 6.

d. Press other keys on the keyboard. Notice that only the keys with brown markings are functional in this mode.

e. Return the keyboard to normal mode by holding down the fn key and pressing F5. The light to the left of the F5 key will go out when normal keyboard mode is restored.

For further information on the PowerBook G3 Series keyboard and Function key, see Technical Information Library article #28505.

Test: Basic PowerBook Usage Skills

Try to answer these questions from memory. If you can't answer them from memory, or if they do not apply to the PowerBook model you were using, refer to the manual for the PowerBook G3 Series computers.

1. What can happen if the AC adapter is attached to the PowerBook computer before it is attached to AC power?
   a. The power manager software may become corrupted.
   b. The PRAM will be automatically reset on startup.
   c. The battery may not charge properly.
   d. Nothing—you can attach the AC adapter to the computer whether or not it is connected to a power source.
2. What is SCSI disk mode?
   a. A way of attaching an external SCSI hard drive to a PowerBook computer.
   b. A way of attaching an internal SCSI hard drive to a PowerBook computer with an internal IDE drive.
   c. A way of using a desktop Macintosh computer as an external hard drive for a PowerBook computer.
   d. A way of using a PowerBook computer as an external hard drive for another Macintosh computer.
3. What cable is required for SCSI disk mode?
   a. HDI-20 cable.
   b. HDI-30 SCSI System cable.
   c. HDI-30 SCSI Adapter cable
   d. SCSI Peripheral Interface cable.
4. Which of the following control panels can be used to set trackball double-click speed (choose all that apply)?
   a. Mouse control panel.
   b. Trackball control panel.
   c. PowerBook control panel.
   d. General Controls control panel.

5. Why should an external monitor be positioned at least eight inches from a PowerBook computer?

   a. To prevent electrostatic discharge problems.

   b. To prevent electromagnetic interference from causing errors in the PowerBook floppy disk drive.

   c. To prevent electromagnetic interference from distorting the monitor's screen image.

   d. To prevent excessive cable tension.

6. When a serial printer is connected to the Modem / Printer port but the Chooser dialog presents two port choices (modem and printer), which port should you select?

   a. Modem.

   b. Printer.

7. Which of the following items distinguish a PowerBook computer notebook from a subnotebook? (Check all that apply.)

   a. The notebook is heavier.

   b. The subnotebook requires a dock to function.

   c. The subnotebook has no built-in floppy drive.

   d. The subnotebook has no networking ports.

8. The PowerBook computer must be shut down or in sleep mode to remove the main battery.

   a. True.

   b. False.

9. What are the possible consequences of hot swapping an expansion bay module on a PowerBook computer that is not hot-swapping capable? (Check all that apply.)

   a. The data is damaged or erased on the floppy or CD.

   b. The module is damaged.

   c. The computer is damaged.

   d. There are no adverse consequences.

   e. The computer automatically restarts, losing unsaved changes.

10. Which of the following are legitimate methods for putting various PowerBook models into sleep mode? (Check all that apply.)

    a. Close the lid.

    b. Disconnect the AC adapter.

    c. Press the power on key and click Sleep.

    d. Choose Sleep from the Special menu.

    e. Choose Sleep from the Control Strip.

11. How do you wake a PowerBook computer from sleep mode?

    a. Tap the monitor.

    b. Touch the track pad.

    c. Press almost any key.

    d. Choose Wake from the Special menu.

12. You adjust the screen brightness and contrast in the Monitors control panel.

    a. True.

    b. False.

13. Taking into consideration all PowerBook models shipping as of May, 1998, which of the following are legitimate methods of starting a PowerBook computer? (Check all that apply.)

    a. Press the Startup Switch plus any key.

    b. Press the Function key.

    c. Press the power button.

    d. Press the power key above the keyboard.

    e. Attach the AC adapter.

    f. Press the power key on the keyboard.

    g. Press the Startup Switch plus the Caps Lock key.

14. What are some of the recommended ways to eject a PC card from a PowerBook computer? (Check all that apply.)

    a. Press the eject button.

   b. Use the “Mac Tool” (paper clip).
   c. Drag the card’s icon to the Trash.
   d. Select the card’s icon and choose Eject from the Special menu.
   e. Pull the card out using the handle.

15. What are some of the recommended ways to shut down various PowerBook models? (Check all that apply.)
    a. Close the lid.
    b. Disconnect the AC adapter.
    c. Choose Shut Down from the Special menu.
    d. Press the power key, then click Shut Down.
    e. Remove the main battery(s) and wait twenty seconds.

16. A PowerBook 1400 must be shut down or in sleep mode to remove an expansion bay module.
    a. True.
    b. False.

Note — When you are finished, compare your answers to those on the following page.

Test: Answers

1. What can happen if the AC adapter is attached to the PowerBook computer before it is attached to AC power?

   a. The power manager software may become corrupted.

2. What is SCSI disk mode?

   d. A way of using a PowerBook computer as an external hard drive for another Macintosh computer.

3. What cable is required for SCSI disk mode?

   c. HDI-30 SCSI Adapter cable

4. Which of the following control panels can be used to set trackball double-click speed (choose all that apply)?

   a. Mouse control panel.

   b. Trackball control panel.

5. Why should an external monitor be positioned at least eight inches from a PowerBook computer?

   a. To prevent electromagnetic interference from causing errors in the PowerBook floppy disk drive.

6. When a serial printer is connected to the Modem/Printer port but the Chooser dialog presents two port choices (modem and printer), which port should you select?

   a. Modem.

7. Which of the following items distinguish a PowerBook computer notebook from a subnotebook? (Check all that apply.)

   a. The notebook is heavier.

   c. The subnotebook has no built-in floppy drive.

8. The PowerBook computer must be shut down or in sleep mode to remove the main battery.

   b. False.

9. What are the possible consequences of hot swapping an expansion bay module on a PowerBook computer that is not hot-swapping capable? (Check all that apply.)

   b. The module is damaged.

   c. The computer is damaged.

10. Which of the following are legitimate methods for putting various PowerBook models into sleep mode? (Check all that apply.)

    a. Close the lid.

    c. Press the power on key and click Sleep.

    d. Choose Sleep from the Special menu.

    e. Choose Sleep from the Control Strip.

11. How do you wake a PowerBook computer from sleep mode?

    c. Press almost any key.

12. You adjust the screen brightness and contrast in the Monitors Control Panel.

    b. False.

13. Taking into consideration all PowerBook models shipping as of May, 1998, which of the following are legitimate methods of starting a PowerBook computer? (Check all that apply.)

    a. Press the Startup Switch plus any key.

    c. Press the power button.

    d. Press the power key above the keyboard.

    f. Press the power key on the keyboard.

14. What are some of the recommended ways to eject a PC card from a PowerBook computer? (Check all that apply.)

    a. Press the eject button.

    c. Drag the card’s icon to the Trash.

    d. Select the card’s icon and choose Eject from the Special menu.

15. What are some of the recommended ways to shut down various PowerBook models? (Check all that apply.)

    c. Choose Shut Down from the Special menu.

    d. Press the power key, then click Shut Down.

16. A PowerBook 1400 must be shut down or in sleep mode to remove an expansion bay module.

    a. True.

PowerBook Theory of Operation 2

Understanding how PowerBook computers work is essential for good troubleshooting and repair. In this module, you will learn basic PowerBook theory of operation—how power is managed, where the components of the logic system are located, and how the built-in display and other unique features of PowerBook computers work. Knowing the overall shape of these systems and the functions of major PowerBook components, you will be able to better understand the possible causes of problems and to decide which troubleshooting steps to take.

What You Will Learn

When you finish this module, you will be able to describe how the major systems of a PowerBook computer operate, and to describe the major components of each system. The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module.

Required Materials and Equipment

This module requires the following materials and equipment:

- PowerBook computer (recommended)
- Apple *Service Source* CD (April 1998 version or later)
- Macintosh computer for use with Service Source (for hardware platform requirements, see the *Service Source* CD booklet)

Time to Complete This Module

This module should take approximately 2.5 hours to complete.

Skills Checklist

If you think you already possess the following skills, go directly to the module exercises. If you are able to complete the exercises without an error, congratulations! Go on to the next module. If not, complete this module before proceeding.

- Given a PowerBook function or feature, identify the module usually responsible for that function, including:

  a. Power:

  _______ ■ Power supplied to the computer

  _______ ■ Power management functions, including battery recharging and automatic power conservation features

  b. Logic:

  _______ ■ CPU and math coprocessor

  _______ ■ System RAM and video RAM

  _______ ■ RAM expansion

  _______ ■ ROM

  _______ ■ Parameter RAM (PRAM)

  c. Display:

  _______ ■ Types of display

  _______ ■ Boards and cables connected to the display

  _______ ■ Power supplied to the display

  _______ ■ Using external displays

  d. Input/output operations (I/O):

  _______ ■ I/O ports and connectors

  _______ ■ PC (PCMCIA) cards

  _______ ■ Internal Ethernet/modem card

  _______ ■ IR (infrared) window

_______ • Given the name of a PowerBook module, indicate the functions it usually performs.

_______ • Given a description of a PowerBook problem and your knowledge of PowerBook theory of operation, identify the most probable cause of the problem.

PowerBook Theory of Operation

A PowerBook computer can be considered in terms of the following functional systems:

- Power system
- Logic system
- Display system
- Input/output system
- Other systems

In different PowerBook models, these systems are located on different modules and components. The following sections will describe how these systems are usually implemented in recent PowerBook models, with notes about major differences in earlier models.

Figure 2-1 shows the PowerBook computers.

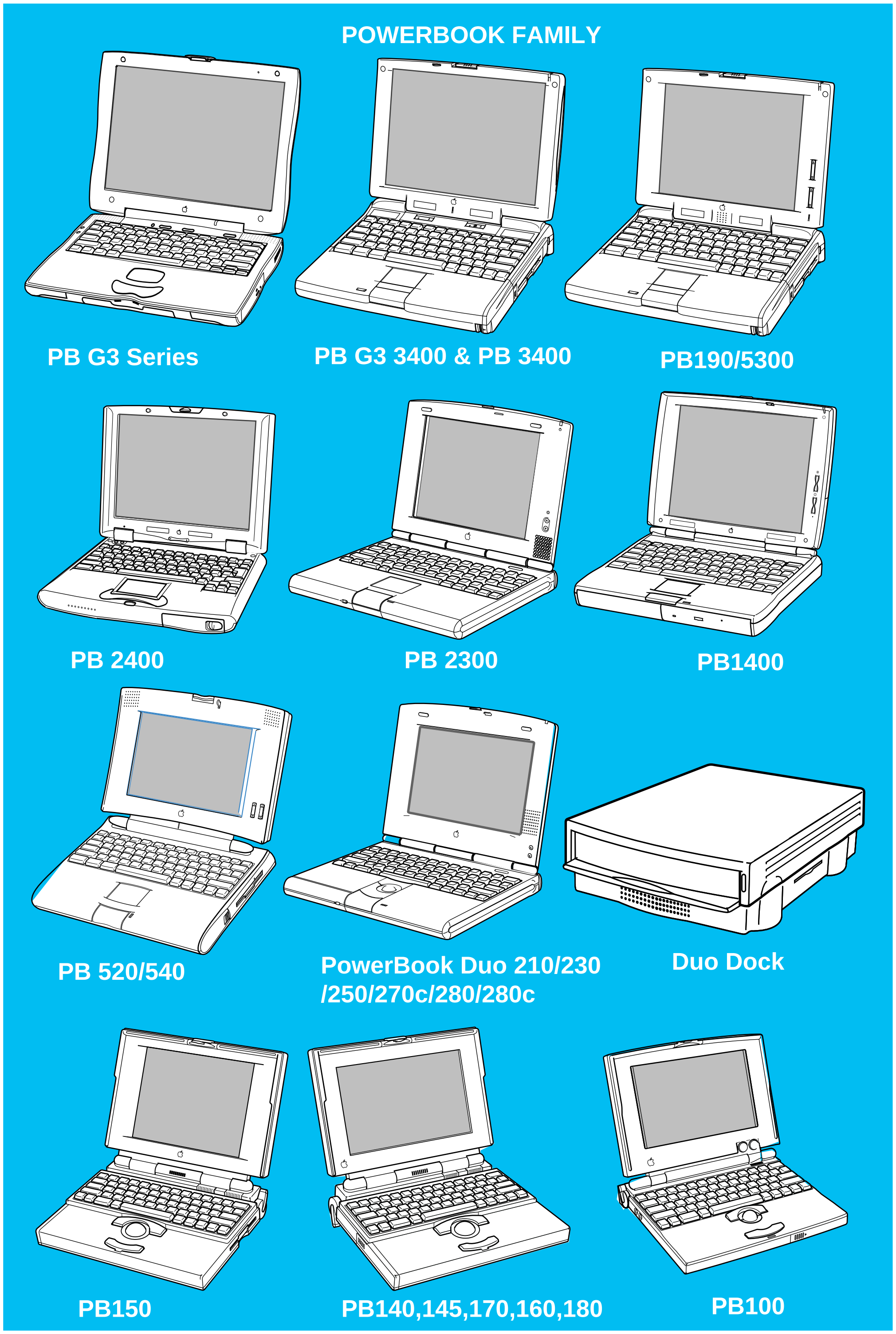


Figure 2-1: The PowerBook Family

The Power System

PowerBook computers can be powered either by batteries or by line voltage, through an AC adapter. In all PowerBook computers, a special chip, the power management unit (PMU), senses whether power is coming from the battery or the AC adapter and regulates PowerBook operations accordingly.

The power management unit controls sleep mode, hard drive spindown, screen dimming, and other power conservation features. The PMU sends instructions about these features to the power supply circuitry (located either on the logic board or on a separate power supply board), which routes power to the rest of the components according to the instructions it receives from the PMU.

Power System Components

The power system includes the main battery, backup battery, and AC adapter.

Main Battery

The main battery puts the “portable” in “portable computer.” The main battery supplies power when the computer is used without the AC adapter. The main battery in the PowerBook G3 Series computer connects through one of the two expansion bays (see Figure 2-2). If desired, two batteries can be used, one in each bay. In some earlier models, the battery bay is separate from the expansion bay, or is the only bay present.

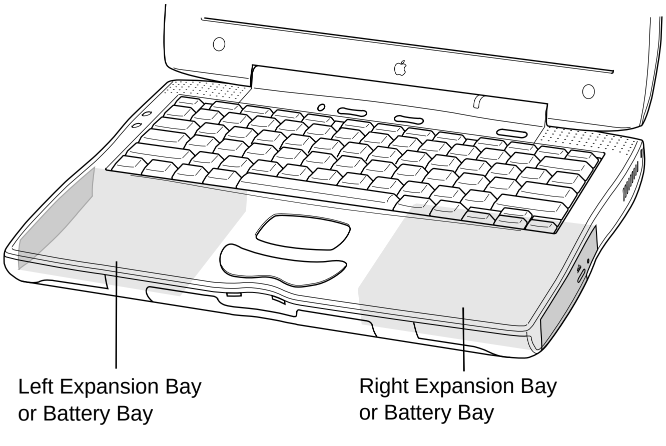


Figure 2-2: PowerBook G3 Series, Battery Bays/Expansion Bays

Recharging the Main Battery – The main battery automatically recharges whenever the PowerBook computer is plugged into line voltage using the AC adapter. Separate rechargers are also available for some PowerBook batteries (for details, see Module 4, Power Management).

Changing the Main Battery – When operating a computer on battery power, you may need to swap in a fresh main battery. Most PowerBook computers allow you to swap the main battery after you put the computer in sleep mode, because a fully charged backup battery (see Backup Battery below) can maintain the contents of RAM for up to four minutes in sleep mode with no other power present. However, to avoid possible data loss, it is safest to shut down the computer or to connect the AC adapter before you change the battery.

Note — See Module 4, Power Management, for descriptions of the different types of PowerBook main batteries and how to handle, maintain, and dispose of them.

Backup Battery

The main function of the backup battery is to maintain the contents of parameter RAM (PRAM) when no power is being supplied by the main battery or the AC power adapter. In some PowerBook models, a fully charged backup battery can also maintain RAM contents for up to four minutes in sleep mode while the battery is being replaced.

The backup battery is rechargeable, but it does not start to recharge until the main battery is fully charged. To fully charge the backup battery, the computer should remain plugged in to AC power for 48 hours.

Location of the backup battery differs in different PowerBook models. On PowerBook 140 through 180c computers, the backup battery is soldered to the interconnect board (described later in this section). In the PowerBook G3 Series, the backup battery is connected to the PMU board (Figure 2-3).

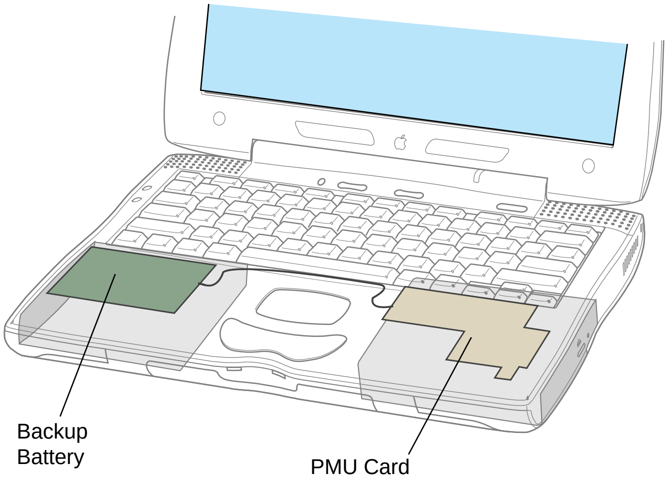


Figure 2-3: PowerBook G3 Series PMU Board with Backup Battery

AC Adapter

The AC adapter (see Figure 2-4) converts AC power to DC voltage, which is then distributed by the power supply circuitry (described later in this section).

The AC adapter provides enough power to run the computer and recharge the main battery at the same time.

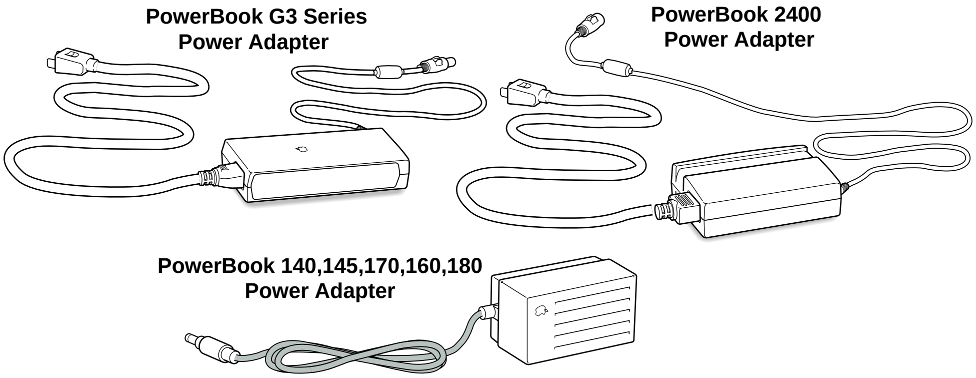


Figure 2-4: AC Adapters for Various PowerBook Models

You can check most PowerBook AC adapters for proper voltage output by using the procedures documented in Service Source.

Troubleshooting Note — If you connect the AC adapter to the computer BEFORE you connect the adapter to an electrical outlet, you can corrupt the power manager software. Symptoms of corrupted power manager software include startup problems and the inability to shut down the computer (the computer restarts spontaneously after shutdown). To fix this problem, you need to reset the power manager. Procedures for resetting the power manager differ depending on the PowerBook model and can be found in the Service Source manual for that model, or in Tech Info Library (TIL) article #14449

Power Manager Unit (PMU)

The power manager unit is an independent central processing unit (CPU) that controls many aspects of the power system. The PMU is located either on the logic board or (in some models) on its own separate board.

The PMU contains its own RAM. The power manager code is contained either in the system ROM or (in later models) in the PMU ROM. When you reset the power manager, you are actually reloading code from the ROM into the PMU RAM.

The PMU performs the following functions:

- Controls the sleep and power on / off sequences.
- Controls power to the other integrated circuits (ICs).
- Controls power conservation features – The PMU sends signals to the power supply circuitry to initiate reduced-power modes when appropriate, following the user preferences indicated in the Energy Saver control panel (or PowerBook and Battery control panels).
- Dims the screen when battery power is low.
- Supports the Apple Desktop Bus (ADB), which is the interface to the keyboard, trackpad, and external ADB port. In this capacity, the PMU monitors keyboard activity, thus allowing the user to wake the computer from sleep by pressing a key on the keyboard.
- Monitors battery charge level.
- Controls battery charging.

If the AC adapter is being used, the PMU directs the power supply circuitry to recharge the battery or batteries (if installed). If the battery is being used, the PMU monitors battery voltage and sends warnings to the main CPU when voltage is getting low.

Startup and shutdown problems (such as, the computer cannot start up or it restarts spontaneously after shutdown) often indicate that the power manager software is corrupt. You can restore proper operation by resetting the power manager. Procedures for resetting the power manager differ depending on the PowerBook model and can be found in the Service Source manual for that model or in Tech Info Library (TIL) article #14449.

The PMU in the PowerBook G3 Series is located on its own PMU board; in most earlier models, the PMU is on the logic board (see Figure 2-5).

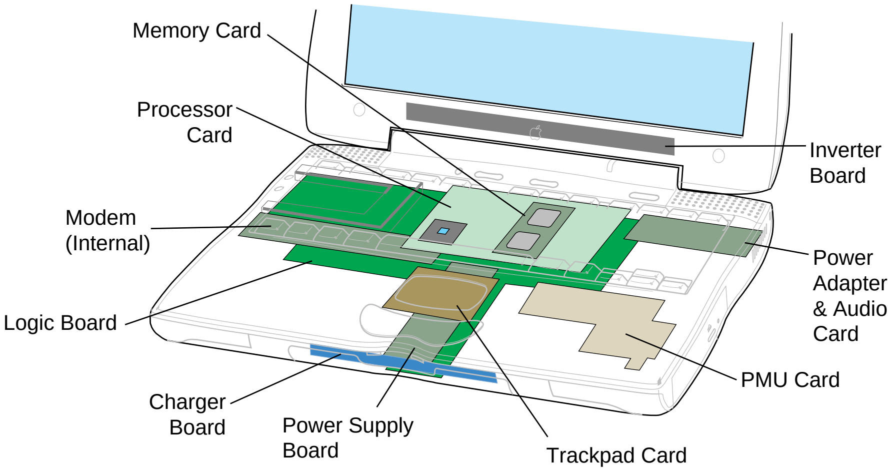


Figure 2-5: PowerBook G3 Series Boards

Power Supply Circuitry / Power Supply Board

The power supply circuitry takes the incoming DC voltage from the battery (or AC adapter) and distributes it to the other boards according to their different voltage requirements (5 volts, 3.3 volts, etc.).

On the PowerBook 5300, 3400, G3, and G3 Series (see Figure 2-5) computers, the power supply circuitry is located on a separate power supply board. In other PowerBook models, the power supply circuitry is located on the logic board.

Troubleshooting Note — If a PowerBook computer exhibits symptoms of power failure (no sound, no video, no activity) even when connected to a known-good power adapter and / or battery, the power supply circuitry may be faulty.

Charger Board

In the PowerBook G3 Series computers, a separate charger board (see Figure 2-6) inside the computer controls the charging of the battery. In most earlier models, this function was controlled by circuitry inside the AC adapter.

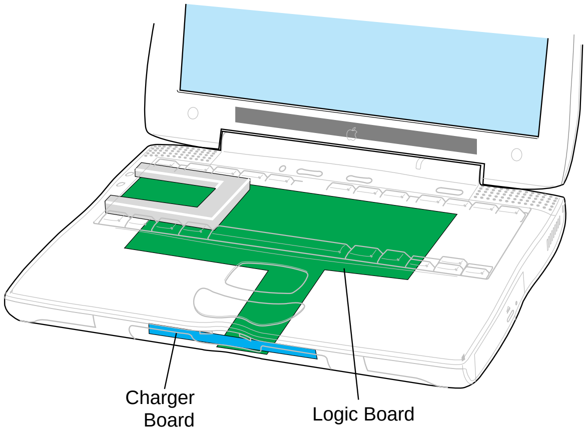


Figure 2-6: Logic Board and Charger Board

Inverter Board / Converter Board

The inverter board takes the DC voltage supplied by the power supply circuitry and converts it to high voltage AC for use with the display backlight. Some PowerBook models also need to pass current through a converter board before the inverter board can use it. (See The Display System, later in this module, for details.)

Interconnect Board or Cable

The interconnect board (present in 100 series and 500 series PowerBook computers and shown in Figure 2-7) passes voltage and signals between modules on the base unit (daughterboard or logic board) and a variety of other modules, including the keyboard, trackpad, inverter board, converter board, and display. On the PowerBook 140 through 180c, the backup battery is soldered to the interconnect board. (See The Display System for details.)

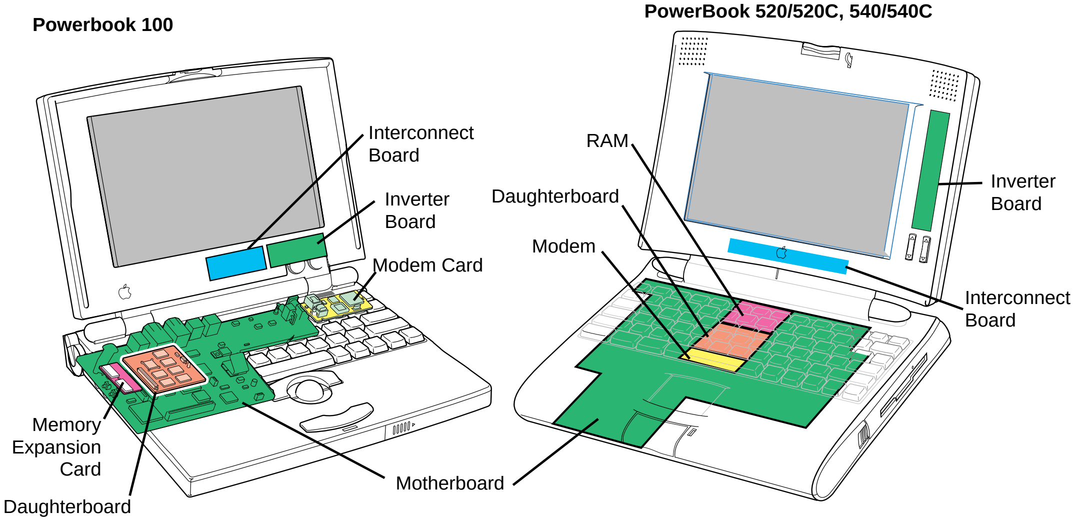


Figure 2-7: Interconnect Board (PB 100 Series and 500 Series)

The Logic System

Because of their compact size and battery conservation considerations, PowerBook computers have different board configurations than desktop Macintosh computers. Instead of a single logic board containing the CPU, RAM, ROM, and other logic chips, PowerBook computers often contain several separate logic-related boards, which are designed to fit the small space available.

Logic System Components

As in desktop Macintosh computers, the logic system in PowerBook computers consists of the following components:

- CPU – The central processing unit (microprocessor). In current PowerBook computers, the CPU is a power-efficient version of a PowerPC chip. In earlier models, the CPU was a member of the Motorola 680x0 family of chips. The CPU is usually located on the daughterboard (called the microprocessor board in some models); if there is no daughterboard, the CPU is located on the logic board.

  In some PowerBook models, the CPU can be upgraded (removed and replaced with a faster CPU). Information on upgrades is available in *Service Source* CD and the TI).
- RAM and ROM – Random-access memory and read-only memory. Usually located on the daughterboard or the logic board. In the PowerBook 165c and 180c, RAM and ROM are located on a separate cousin card.
- ASICs – Apple specific integrated circuit. Special purpose logic chips optimized for specific functions. ASICs control common repetitive functions such as disk access. This frees the CPU for other tasks and speeds up the overall throughput of the computer. Most ASICs are located on the logic board.
- PRAM – Parameter RAM. PRAM stores date and time settings and other system preference data.
- VRAM – Video RAM. VRAM stores data to be displayed on the screen. With more VRAM, more colors and higher screen resolutions are available.

  In most PowerBook models, VRAM is located on the daughterboard or logic board. In the PowerBook 190/5300 series, VRAM for external video is located on a separate video board. Currently no PowerBook models support VRAM upgrades.

- Cache RAM – Cache RAM is fast RAM used to store data for CPU operations. Level 1 cache RAM is part of the CPU itself; level 2 (L2) cache RAM is on separate chips. *Conventional L2* cache is connected to the system bus, and the speed of its transactions with the CPU is limited by the system bus speed. *Level 2 backside* cache (a new feature of G3 computers) is located on the same board as the CPU (processor board) and is connected directly to the CPU through its own high-speed bus. The L2 backside cache has its own high-speed bus, which allows the system to run significantly faster than conventional L2 cache.

Logic System Modules

The logic system modules include the logic board (motherboard), microprocessor board (daughterboard), and cousin card.

Logic Board (Motherboard)

The central board (Figure 2-8) in most PowerBook computers is called the *logic board* (or *motherboard*). In the G3 Series computers, the central board is called the *I/O logic board*).

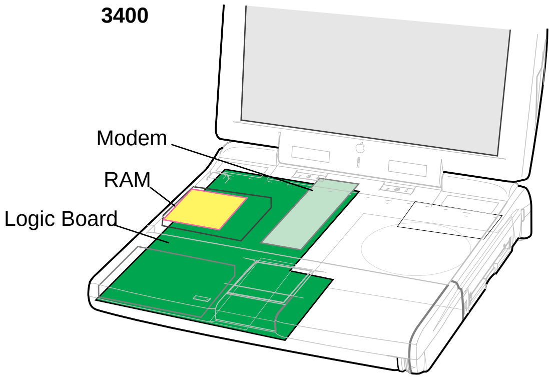


Figure 2-8: Logic Board

The logic board usually contains the following components:

- Interface (I/O) circuitry, controlling all drives and ports
- Peripheral ports and expansion connectors
- Power management circuitry, including PMU
- Battery recharging circuitry
- Power supply circuitry, which converts battery or AC adapter voltage into the +5 and -5 volts needed by other components
- Real-time clock chip
- Parameter RAM (PRAM)

- Audio circuitry
- Fuse

In PowerBook computers that do not contain a daughterboard, the logic board also contains the CPU, RAM, ROM, VRAM, and other logic chips.

Daughterboard (Microprocessor Board)

In many PowerBook models, the central processing unit (CPU) is located on its own board. In the 100 series and the 500 series computers, this board is called the *daughterboard*, and it also contains a number of other important components (see list below). In the G3 Series computers, the board that holds the CPU is called the *processor* or *microprocessor* board (Figure 2-9).

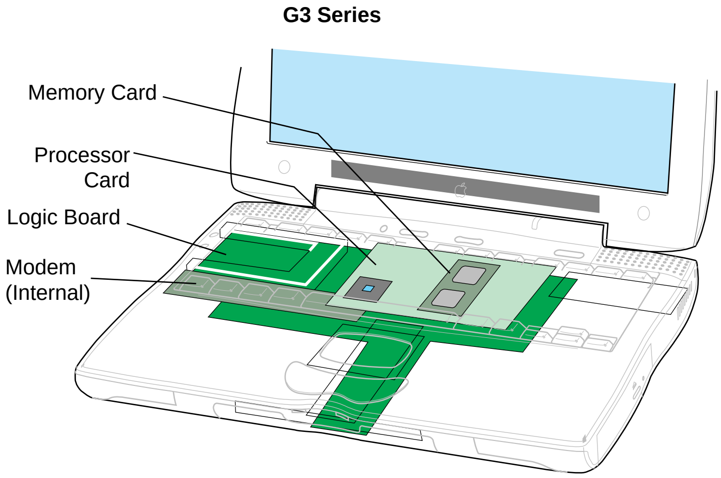


Figure 2-9: G3 Series Processor Card (Daughterboard)

The daughterboard or microprocessor board may also hold system RAM, ROM, and other important components of the logic system. In models that do not contain a daughterboard, these components are usually located on the logic board.

In addition to holding the CPU, the daughterboard may contain one or more of the following components:

- Math coprocessor – Also known as the floating-point arithmetic unit (FPU), adds arithmetic and trigonometric processing additional to that provided by the CPU. (In PowerPC-based computers the FPU is part of the CPU.)
- ROM – Read-only memory. Contains system command sets.

- RAM – Random-access memory. Provides memory for system software and applications. In sleep mode, the contents of RAM are maintained. Shutting down the computer erases RAM contents.
- RAM expansion slot – Allows installation of a RAM expansion card. (In models without a daughterboard, the RAM expansion slot is on the logic board.)
- Video RAM – Supplies display memory additional to that provided in main memory. (VRAM is located on the logic board on the PowerBook 500, 1400, and G3 Series units.)
- Video output circuitry – May include a display driver chip (DDC); a grayscale controller and/or color look-up chip; a video output chip; and a video connector. (Video output circuitry is located on the logic board on the PowerBook 1400 and 500 and G3 Series units.)
- Keyboard controller – Interprets keyboard input.

Cousin Card

The PowerBook 165c and 180c place system RAM and ROM on a cousin card. The cousin card (Figure 2-10) is connected to the daughterboard and rests on top of it.

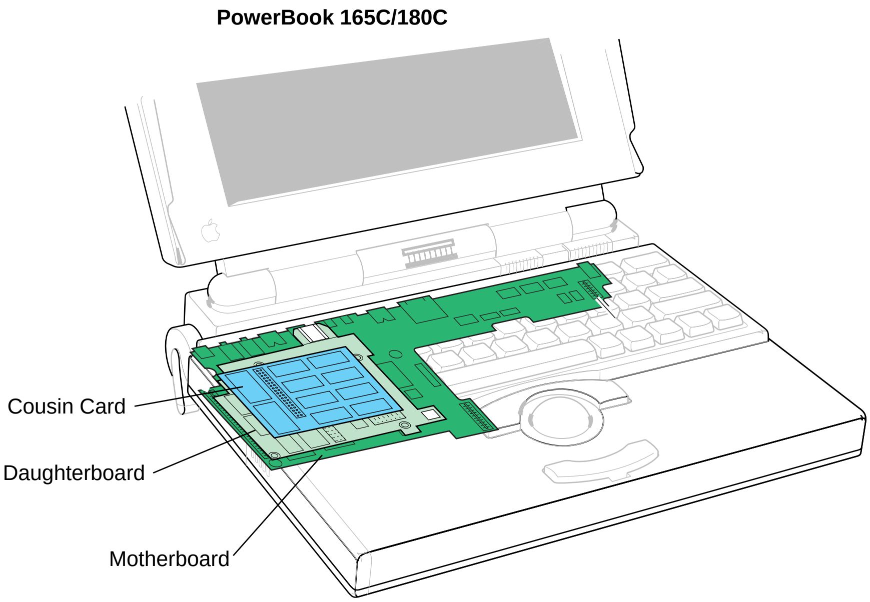


Figure 2-10: Cousin Card

The Display System

This section discusses the types of liquid crystal displays in PowerBook computers and the various modules that are part of the display system.

Liquid Crystal Displays (LCDs)

The flat-panel displays on PowerBook computers are liquid crystal displays (LCDs). LCDs can be either grayscale or color. All recent PowerBook models have color LCDs.

The pixels in LCDs do not create their own light; rather, their light is supplied by a fluorescent backlight. Depending on the current applied to the liquid crystal material, the light from the backlight is either passed through or blocked. The brightness control adjusts the brightness of the backlight, and the contrast control adjusts the intensity, or darkness, of the pixels.

Troubleshooting Note — A certain number of defects are inherent in LCD technology and vary by many factors, including type of technology. If you suspect that a display contains an abnormal number of defects, call Apple Technical Support.

LCD displays use two basic technologies, passive matrix and active matrix.

Passive-Matrix FSTN Displays

In a passive-matrix FSTN (film supertwisted nematic) display, two grids of electronic control wires (lines) are used, one for columns, one for rows. Pixels are located at the junctions of the row and column lines. When both row and column lines are energized, a pixel is turned on; when both lines are de-energized, the pixel goes off. Passive matrix displays use one transistor to address each row and one to address each column.

Passive Matrix DSTN Displays

Passive-matrix displays that use the new DSTN (dual-scan supertwist nematic) technology produce sharp colors, which rival the quality of active-matrix displays.

The PowerBook G3 Series computers may contain either a passive-matrix DSTN display or an active-matrix display.

Troubleshooting Note — DSTN technology uses two half-sized screens (one above the other) to enhance redraw speed. Essentially, the image is split into two halves which are scanned onto the two halves of the display at the same time. A line is sometimes visible where the two halves of the display meet. This line, which will be horizontal and centered, is a normal feature of the display and not a cause for repair or replacement.

Active-Matrix Displays

In an active-matrix display (also called a *thin-film transistor* or TFT display), each pixel is individually controlled by from one to four transistors. This use of multiple transistors allows pixels to be turned on and off at a very fast rate, and to be totally independent. However, active-matrix technology is more expensive than passive-matrix technology.

Active-matrix displays have a wider viewing range than passive matrix—that is, you can see information displayed on the screen from a wider side-angle on an active-matrix display than on a passive-matrix display. Active-matrix displays also have greater resolution and quicker refresh rates.

Most active-matrix displays have fixed contrast. For that reason, most PowerBook computers with active-matrix displays have no contrast control.

Display System Modules

The display receives data, voltage, and control signals from the daughterboard or logic board (through the interconnect board or cables).

If the display fails to operate properly, possible causes could include the board that contains the display driver chip and video RAM (daughterboard or logic board), and the inverter, interconnect, and converter boards (if present), as well as the display.

Interconnect Board (100 and 500 series)

In PowerBook 100 series and 500 series computers, the interconnect board (see Figure 2-12) passes voltage and signals between modules on the base unit (daughterboard or logic board) and a variety of other modules, including the inverter board, converter board (if present), display, keyboard, and trackpad.

On other PowerBook models, the logic board performs the function of the interconnect board.

Troubleshooting Note — Symptoms of a bad interconnect board include display problems (lines on the display, no image at all on both 100 series and 500 series computers) and no sound from the internal speakers (100 series computers).

Inverter Board

The inverter board (Figure 2-11 and Figure 2-12) supplies power for the display and backlight. The inverter board changes DC voltage (received by way of the interconnect board) into the AC voltage required to power the display backlight. The inverter board controls the bias (and therefore the brightness and contrast) of the display.

Displays and their accompanying inverter boards are not all interchangeable. In some PowerBook models, the inverter board cannot be replaced separately but is part of the display assembly. Check the Service Source Parts Database for compatibility information on displays and boards.

Troubleshooting Note — If brightness and contrast cannot be adjusted, the inverter board is probably faulty. In addition, a failure of the display backlight is most likely the result of a faulty backlight or a faulty inverter board.

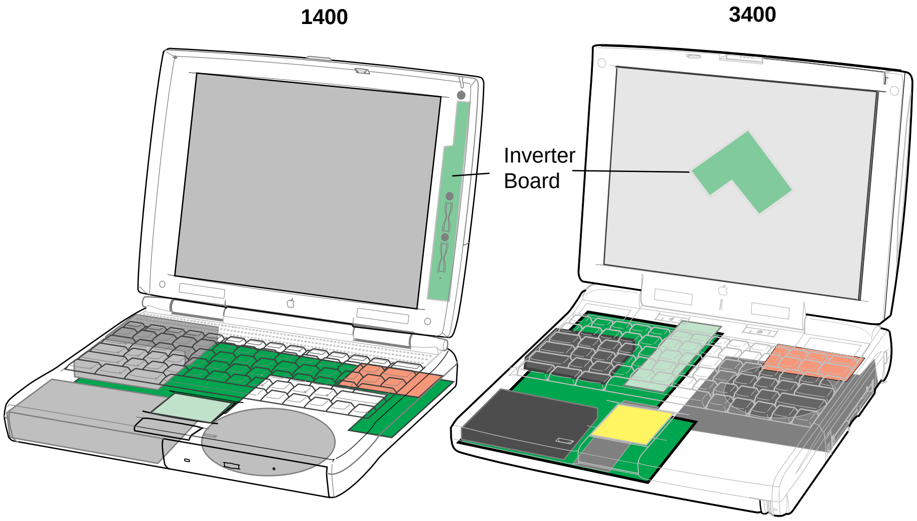


Figure 2-11: Inverter Board

Converter Board

In addition to the inverter board, the PowerBook 165c and 180c computers have a converter board (Figure 2-12). The converter board converts 5 VDC to 12 VDC and sends it to the inverter board, where it is inverted to the AC voltage required to power the display backlight.

Troubleshooting Note — On computers having both a converter board and an inverter board, a failure of the backlight can be caused by either one or both of these boards, as well as by a faulty backlight.

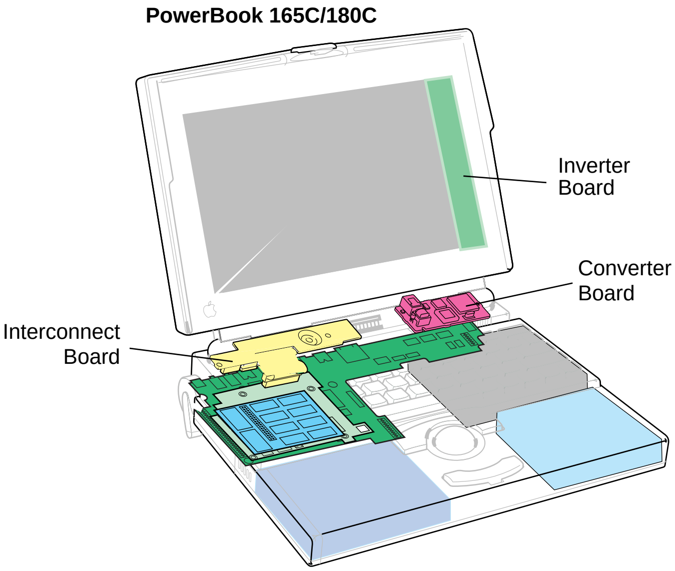


Figure 2-12: Converter, Interconnect, and Inverter Boards

Backlight

In some early PowerBook models, the backlight bulbs are available as a separate part. In most models, the backlight is not a separate module but is part of the display assembly.

The Input/Output System

This section describes the built-in I/O devices, ports and connectors of all PowerBook computers.

Built-in I/O Devices

All PowerBook computers include the following input devices:

- Keyboard
- Trackpad or trackball
- Microphone
- Speakers

Keyboard

The built-in keyboard on recent PowerBook computers includes function keys and a power key. Some earlier PowerBook models lacked these keys.

The PowerBook G3 Series keyboard contains a special Function key (fn). See Module 1, PowerBook Basics and Usage Skills, for more details about the fn key.

Trackpad or Trackball

Instead of a mouse, PowerBook computers ship with a trackpad or a trackball. With a trackpad, you control the cursor by dragging your finger along the surface of the trackpad. The trackpad senses the capacitance of the your finger and moves the pointer accordingly. Clicking and double-clicking are done by clicking the trackpad actuator (see Figure 2-13).

In the PowerBook 190, 1400, 2400, 3400, G3, and G3 Series computers, the trackpad responds to one or two taps on the pad itself as if the user had clicked or double-clicked the trackpad actuator, if this option is selected in the Trackpad control panel.

Many early PowerBook models used a trackball instead of a trackpad.

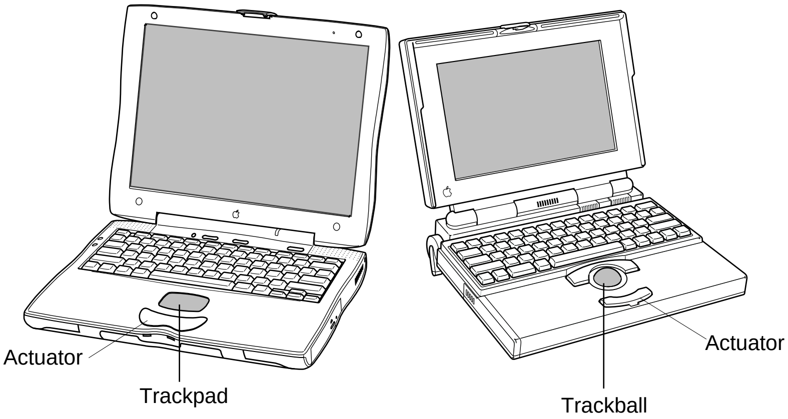


Figure 2-13: Trackpad and Trackball

Microphone

Most recent PowerBook computers include a built-in microphone Figure 2-14). On some early models, you must attach a microphone to the sound-in port.

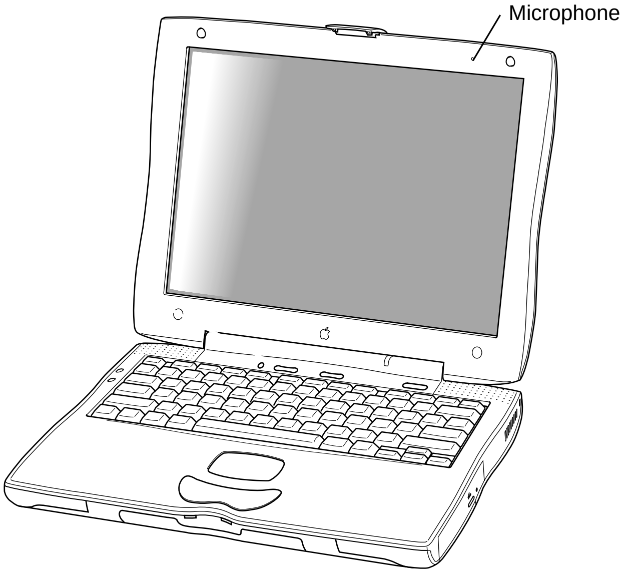


Figure 2-14: Microphone

Speakers

All PowerBook models have built-in speakers (Figure 2-15), but the number and location of the speakers varies.

For example, PowerBook 2400 and 1400 computers have one speaker, located in the base unit. PowerBook 500 series computers have two speakers, located in the display bezel. Powerbook 3400 computers have four speakers, two in the bezel and two in the base unit. Consult Service Source or the User's Guide for more information.

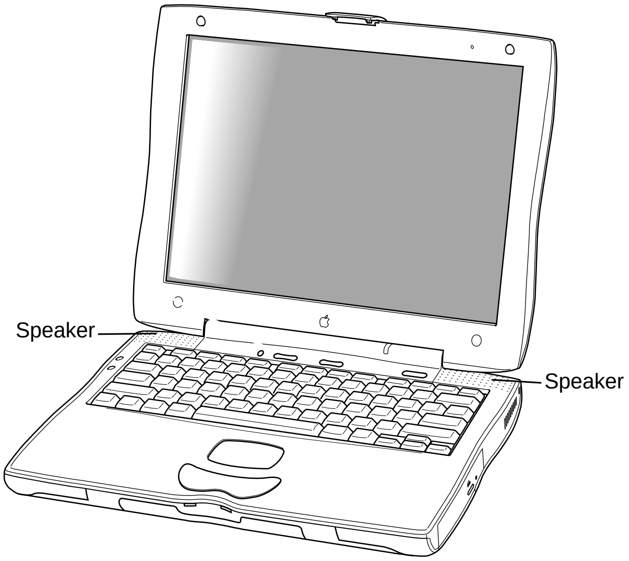


Figure 2-15: G3 Series Speakers

Basic Ports and Connectors

Almost all PowerBook computers include the following I/O ports and connectors:

- ADB (Apple Desktop Bus)
- Serial port(s)
- SCSI port
- Sound-out port
- Sound-in port

ADB (Apple Desktop Bus)

The ADB (Apple Desktop Bus) connector (Figure 2-16) allows the user to attach a mouse and/or an external keyboard to the computer. Only low-power ADB devices should be used with PowerBook computers. Use of a normal mouse or keyboard will not harm the computer but will contribute to faster consumption of battery charge.

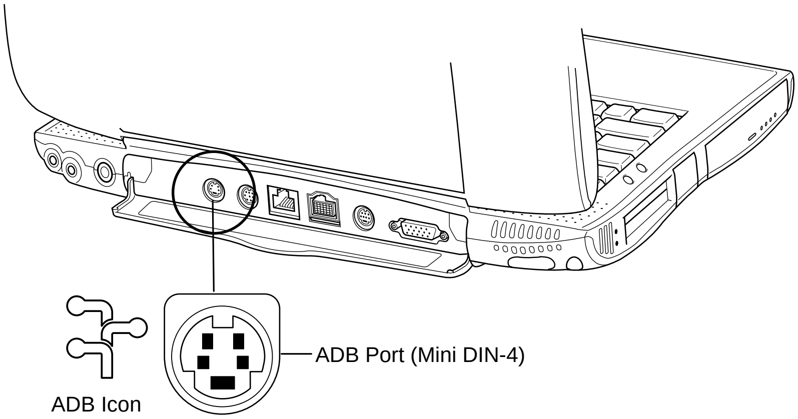


Figure 2-16: ADB Port and Icon

Serial (Modem/Printer) Port(s)

Some PowerBook models contain two serial ports, the modem port and the printer port; others have a single, combined modem / printer port (Figure 2-17).

Serial ports allow you to connect the computer to external serial devices, such as printers or external modems, or to LocalTalk devices (such as a LaserWriter printer) or to a LocalTalk network.

Note — With some early printer drivers, such as the StyleWriter II driver, the Chooser may show two port choices, printer and modem, even when only one port exists. If you are given two choices for the port, select the modem port.

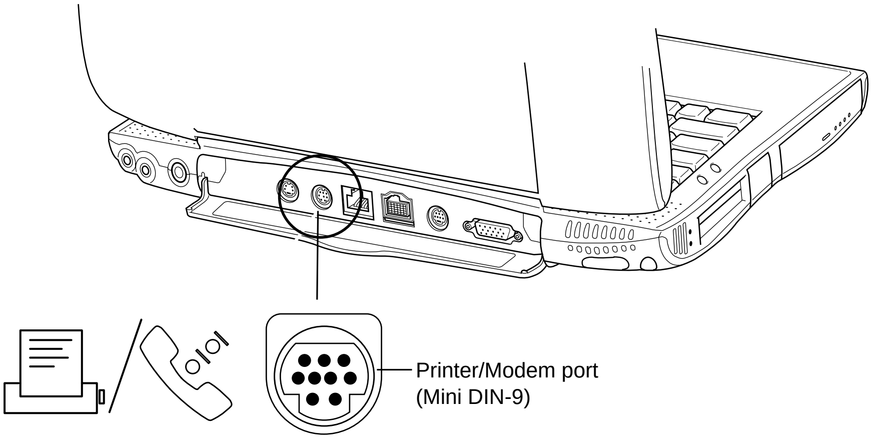


Figure 2-17: Serial Port with Printer/Modem Icon

SCSI Port (HDI-30)

The SCSI port (Figure 2-18) can be used in two ways:

- If an Apple HDI-30 SCSI Disk Adapter cable is connected to the SCSI port, the PowerBook computer can be connected to another Macintosh in SCSI disk mode (sometimes called *target disk mode* or *HD target mode*).

Note — Not all PowerBook computers support SCSI disk mode.

- If an Apple HDI-30 SCSI System cable is connected to the SCSI port, external SCSI devices, such as hard disks and CD-ROM drives, can be connected to the PowerBook computer.

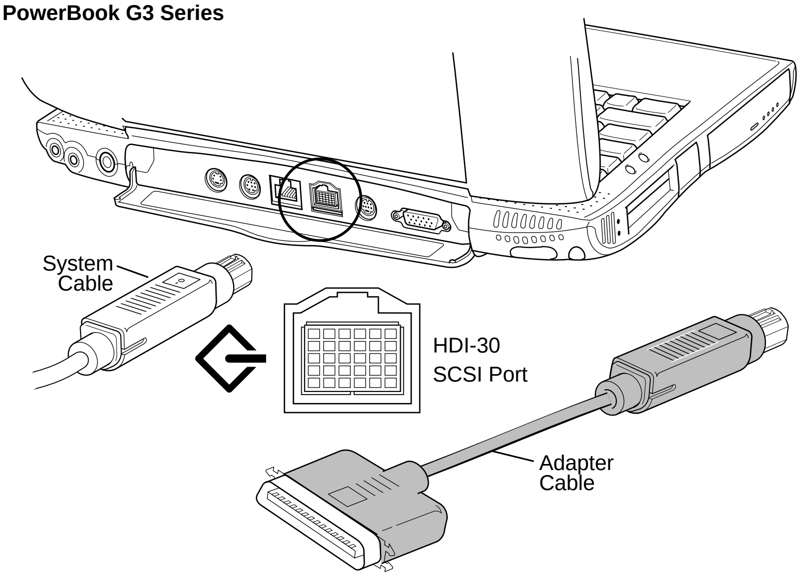


Figure 2-18: SCSI Port and Icon, System Cable, and Adapter Cable

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Warning — Before you connect a SCSI cable or device to a PowerBook computer, always turn off power to all devices, including the computer. Failure to do so could damage the equipment.

Slow SCSI Extension – The PowerBook 1400 needs additional software (the Slow SCSI Extension) to transfer data correctly with external SCSI devices that are relatively slow, such as an Iomega Zip drive, a 1x or 2x CD-ROM drive, or another PowerBook computer that is connected to it as a hard disk (in SCSI disk mode). The PowerBook 5300 may also need the Slow SCSI Extension in some instances. Refer to the TIL for current information.

Sound-Out Port

The sound-out port (Figure 2-19) allows external speakers to be connected. If external speakers are connected to the sound-out port, audio output is automatically routed to that port, and the internal speakers are automatically turned off.

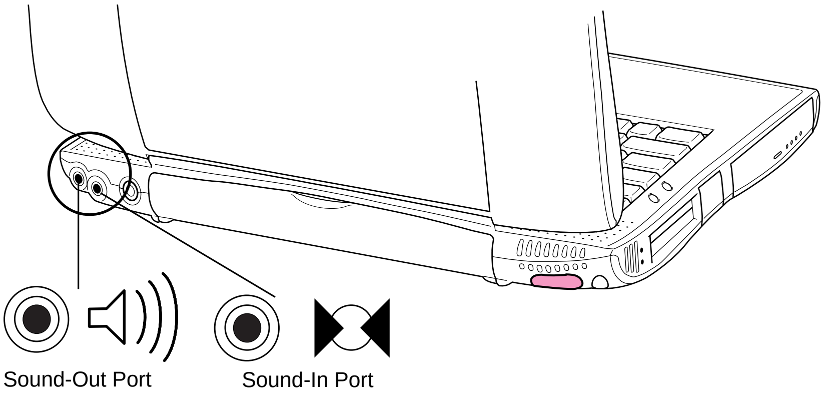


Figure 2-19: Sound-In and Sound-Out Ports and Icons

Sound-In Port

The sound-in port (Figure 2-19) allows an external microphone (or, in some models, line input from an external sound source) to be used as a source of audio input. Consult the User’s Guide or the TIL to identify compatible input devices.

Additional Ports and Connectors

Later model PowerBook computers may also contain some or all of the following ports and connectors:

- IR (infrared) window
- PC card (PCMCIA) slots
- Expansion bay (media bay)
- Video port
- External TV out port (S-Video out port)
- PDS (processor direct slot) connector
- Internal modem port
- Ethernet port
- Internal Ethernet / modem port

IR (Infrared) Window

The IR window (Figure 2-20) allows input and output of data to other IR-capable devices, including some third-party products and other PowerBook computers.

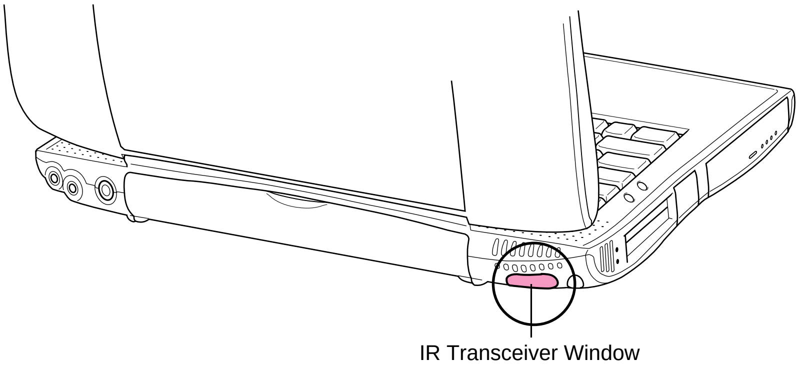


Figure 2-20: IR Window

PC Card (PCMCIA) Slots

Most PowerBook computers have two PC card slots (Figure 2-21). PC card compatibility was first introduced as an option with the PowerBook 500 series, and built-in PC card slots have been a feature of all later PowerBook notebook models.

The PC card slots accept either one Type III card or two Type I or II cards. In PowerBook G3 Series computers, the slots support both 16-bit PC cards and the newer 32-bit CardBus cards. (CardBus is the 32-bit version of the PCMCIA PC card standard.)

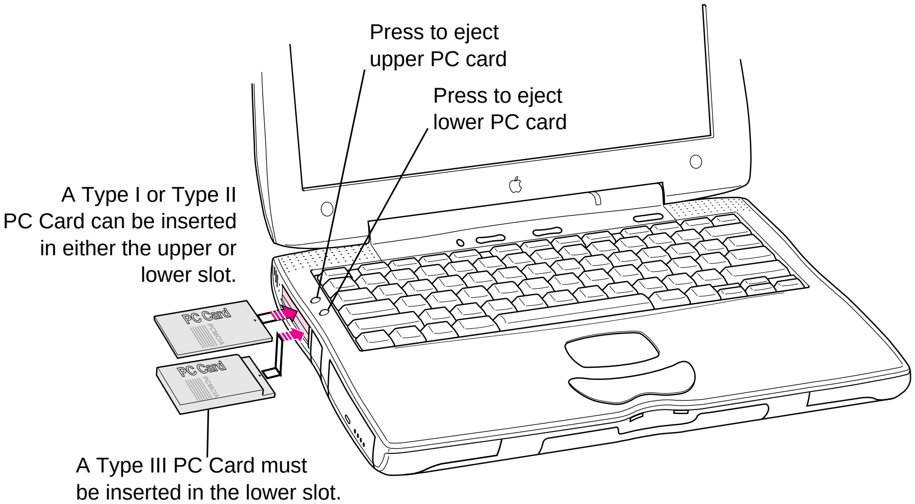

Press to eject
upper PC card
Press to eject
lower PC card
A Type I or Type II PC Card can be inserted in either the upper or lower slot.
PC Card
PC Card
A Type III PC Card must be inserted in the lower slot.

Figure 2-21: PC Card and Slot

The PowerBook 500 series computers require an optional adapter module to use PC cards. The adapter fits into the PDS slot in the left battery bay.

The PowerBook G3 Series accepts Zoomed Video cards in the lower PC card slot. (Zoomed Video is a method of displaying video signals sent from a PC card.)

Expansion Bay (Media Bay)

The expansion bay (sometimes called the media bay in earlier PowerBook models) allows insertion of a CD-ROM drive, floppy drive, or other compatible device. PowerBook G3 Series computers contain two expansion bays (Figure 2-22). Some PowerBook expansion bays accept batteries. See the User Guide, Service Source, or the TIL for model-specific information.

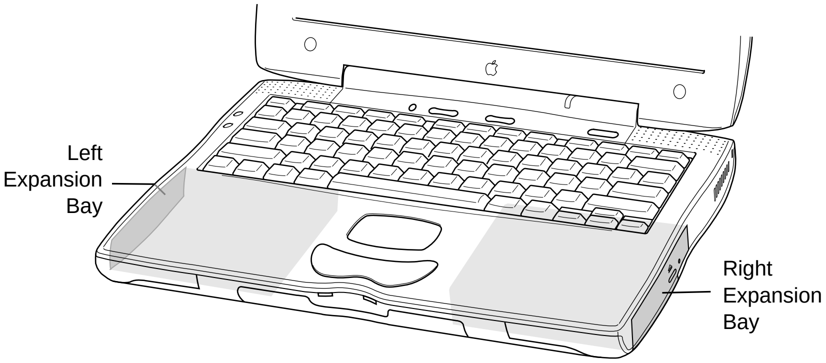


Figure 2-22: PowerBook G3 Series Expansion Bays

Expansion Module Removal/Insertion – Some but not all PowerBook models allow hot swapping. See the User Guide, Service Source, or the TIL for model-specific information.

Expansion Module Compatibility – Expansion bay modules are not all compatible across PowerBook models. For specific compatibility information, see the Service Source Parts DataBase, Service Source hardware manuals (Basics chapter) for specific computers, or the TIL.

Video Port

The video port (Figure 2-23) allows you to connect an optional external monitor.

In some PowerBook models, an external monitor can be used either as a mirroring monitor for presentation purposes, or as an additional screen to add desktop space. See the User's Guide for further information.

Troubleshooting Note — To avoid causing errors on floppy disks, the external monitor must be at least eight inches away from the floppy drive of the PowerBook computer.

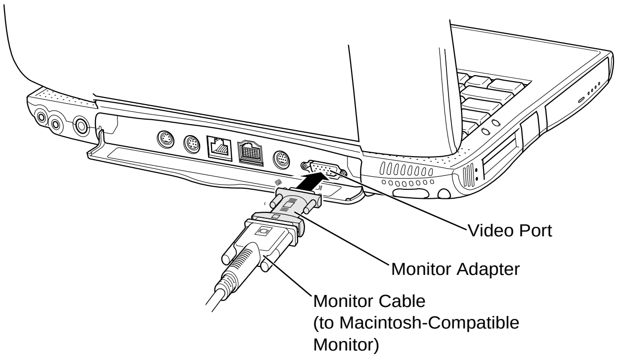


Figure 2-23: Video Port

External TV Out Port (S-Video Out Port)

The external TV out port connects a PowerBook G3 Series computer to any television, VCR, or other video device that supports S-Video, NTSC, or PAL formats. This option is new with the PowerBook G3 Series models. Using this port, the user can view the PowerBook desktop on a television screen and record images from the desktop to a VCR.

Warning — The S-video out port (Figure 2-24) resembles the ADB port and the printer / modem port. Always plug S-video devices into the S-video out port.

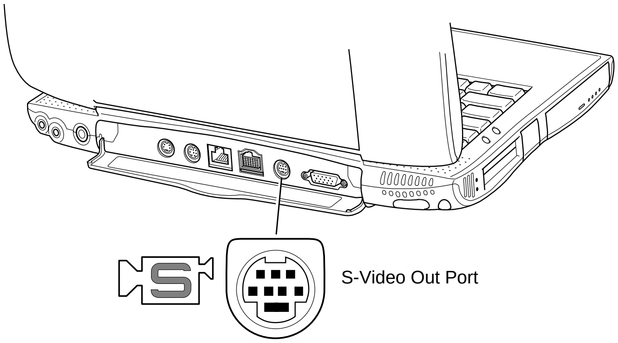


Figure 2-24: S-Video Out Port and Icon, G3 Series

PDS Connector

A processor direct slot (PDS) brings the microprocessor address, control, and data lines, along with other model-specific signals, to a single expansion connector on the main logic board.

Not all PowerBook models contain a PDS connector. When present, the PDS connector can have a variety of uses. For instance, in the PowerBook 500 series, a PC card adapter module is often attached to the PDS connector; in the PowerBook 190 and 5300 computers, the PDS slot is most often used to hold an Apple or third-party video card for use with an external video monitor.

Refer to the specific PowerBook user's guide, the Service Source hardware service manual, or the TIL for product-specific information.

Internal Modem Port

Internal modem cards are available for most PowerBook computers. When installed, these cards provide an external port (Figure 2-25) for connecting to a telephone line.

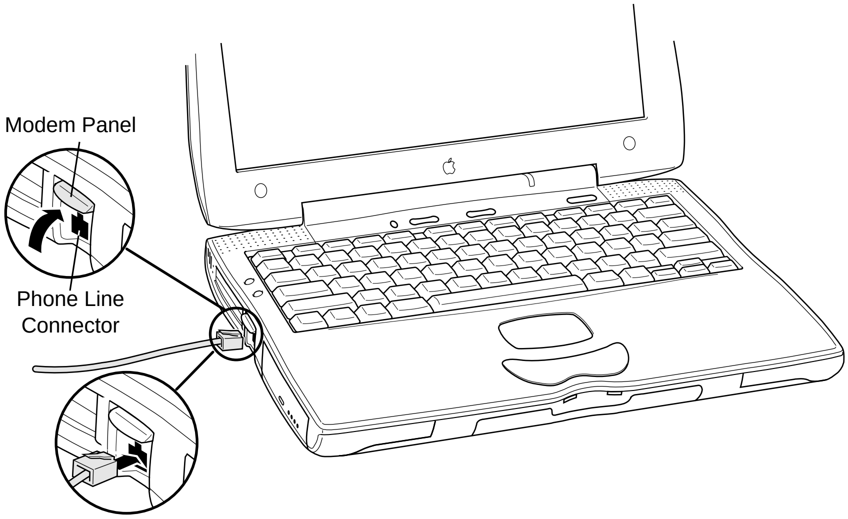


Figure 2-25: G3 Series Internal Modem Port

Ethernet Port

Some PowerBook computers, including the PowerBook 500 Series, contain a built-in Ethernet port (Figure 2-26). The PowerBook G3 Series computers contain a built-in 10 Base-T Ethernet connector.

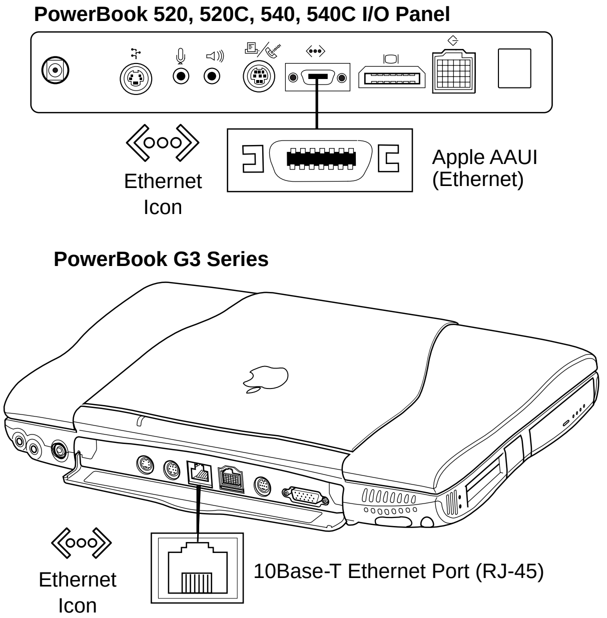

PowerBook 520, 520C, 540, 540C I/O Panel
Ethernet Icon
Apple AAUI (Ethernet)
PowerBook G3 Series
Ethernet Icon
10Base-T Ethernet Port (RJ-45)

Figure 2-26: Built-In Ethernet Port and Icon

Internal Ethernet/Modem Port

Combined Ethernet / modem cards are available as an option for PowerBook 3400 and G3 computers. When installed, these cards provide an external port (Figure 2-27) for connecting to a network, to a phone line, or to a Y-adapter that allows both Ethernet and modem connections at once.

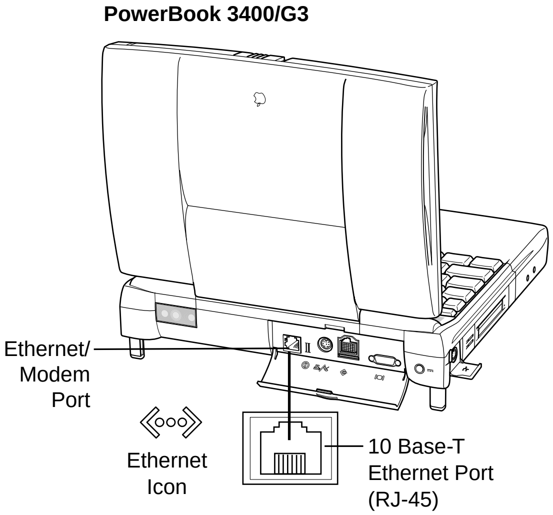


Figure 2-27: Ethernet/Modem Card Port

Special I/O Ports and Connectors

The 152-pin PDS expansion connector and floppy drive port are found only on PowerBook Duo computers and on unique models, as listed below.

152-Pin PDS Expansion Connector

The PowerBook Duo uses a 152-pin PDS expansion connector (Figure 2-28) to connect the computer to an optional Duo Dock, MiniDock, or Duo Floppy Drive Adapter.

See the PowerBook 200 Service Training course for more details.

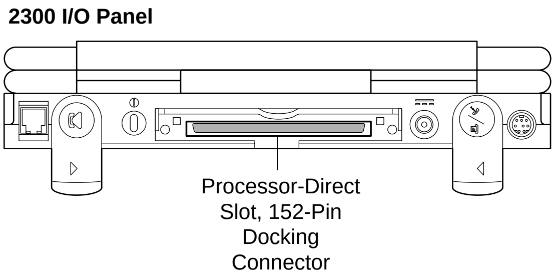


Figure 2-28: PowerBook Duo 2300 152-Pin PDS Connector

Floppy Drive Port

In PowerBook 100 computers (but not the rest of the 100 series), a built-in HDI-20 floppy disk drive port (Figure 2-29) allows an external floppy drive to be connected. This port is necessary because the PowerBook 100 has no internal floppy drive.

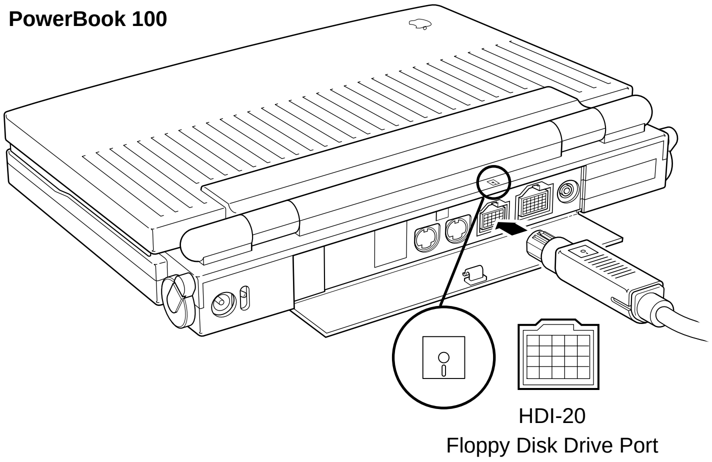


Figure 2-29: HDI 20-Floppy Disk Drive Port

PowerBook Duo computers (200 series and 2300c) have neither an internal floppy drive nor an HDI-20 port. To add an HDI-20 port, you can attach a MiniDock or a Duo Floppy Drive Adapter to the 152-pin PDS expansion connector.

PowerBook 2400 computers have a special 26-pin floppy drive port, which can only be used for the PowerBook 2400 external floppy drive.

For more details, see the PowerBook 100 Series and 200 Series Service Training courses and the Service Source hardware service manuals for the specific PowerBook models.

Figure 2-30 and Figure 2-31 show the I/O ports of the PowerBook computers, and Figure 2-32 shows the I/O pinouts.

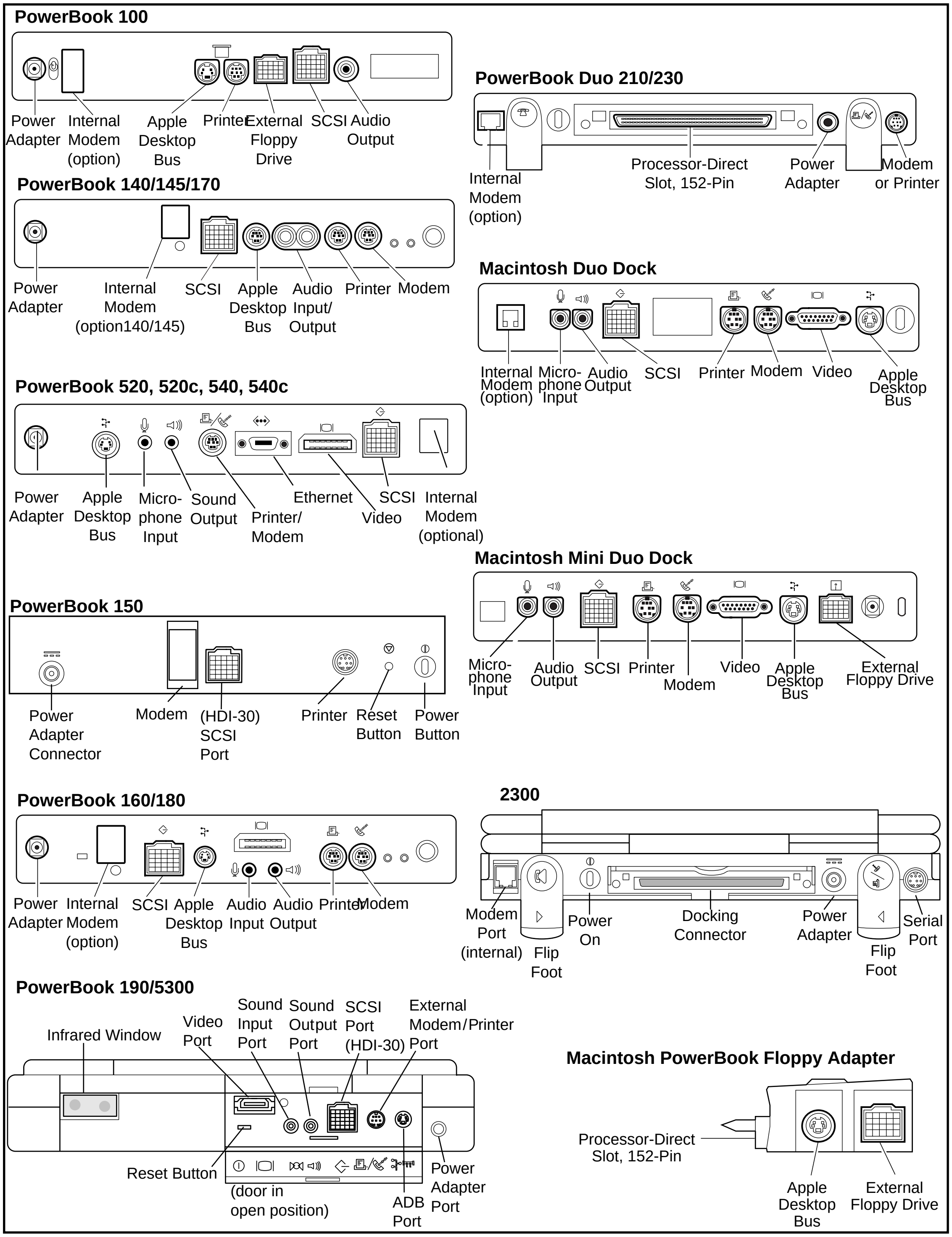


Figure 2-30: I/O Ports, Earlier PowerBook Computers

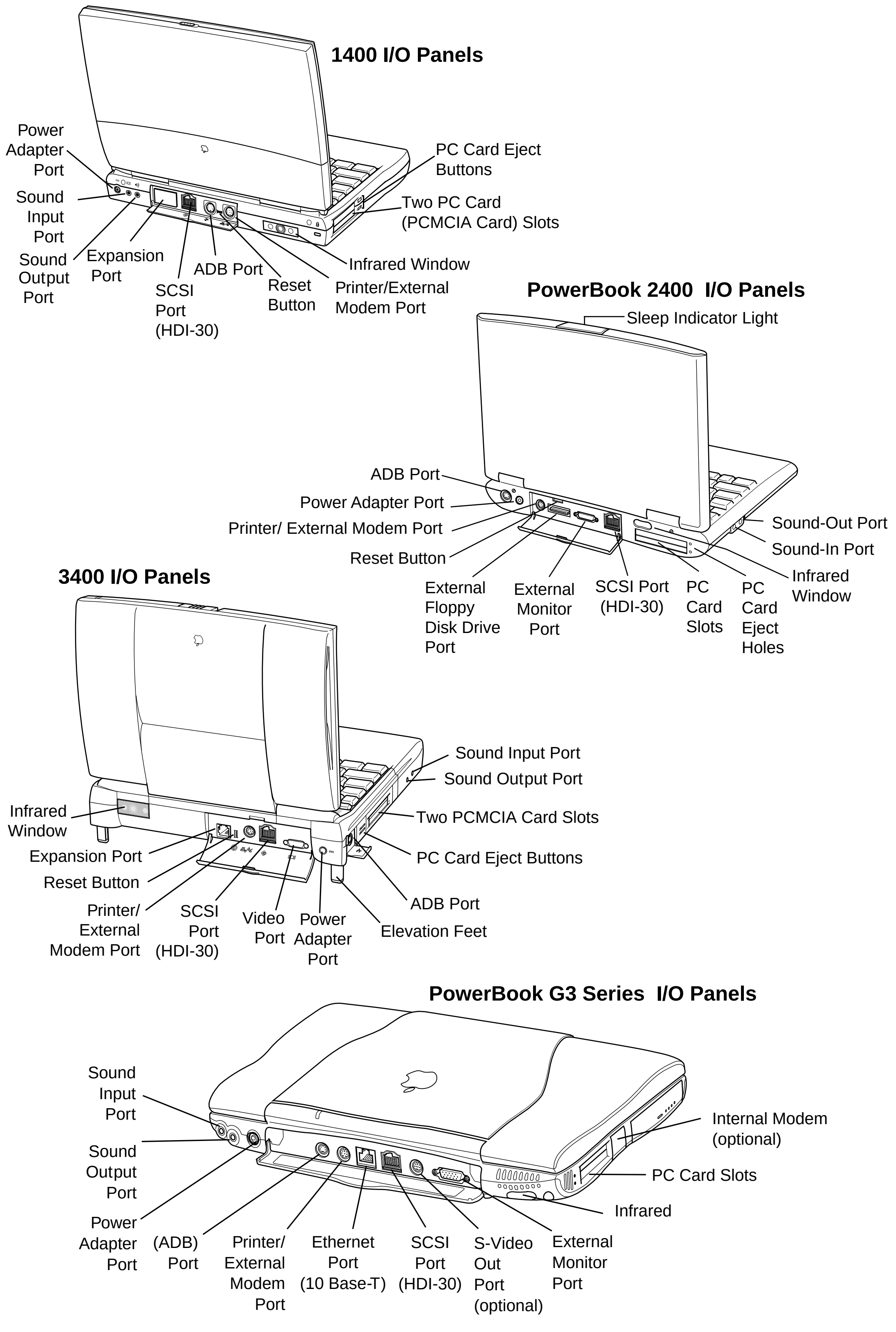


Figure 2-31: I/O Ports, Later PowerBook Computers

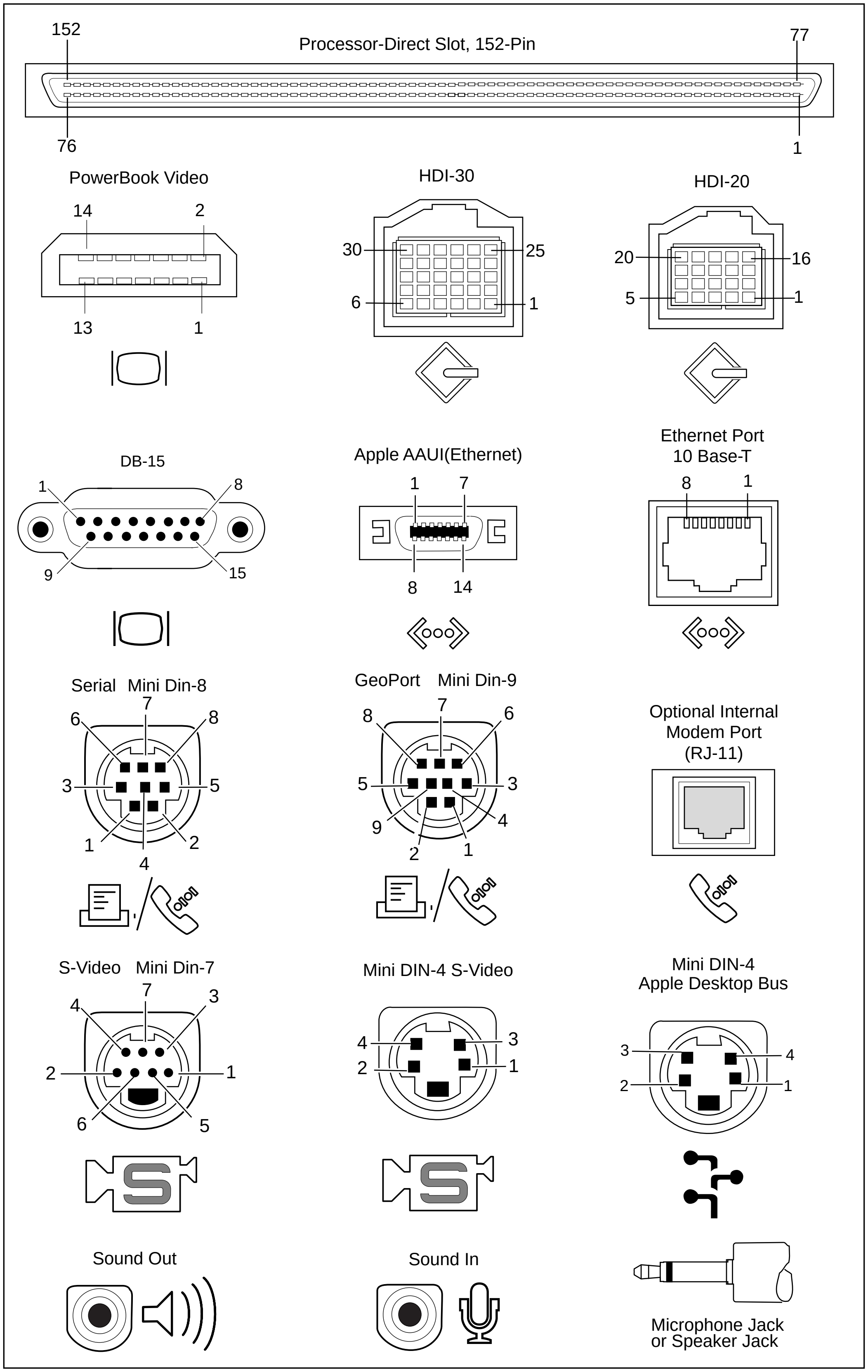


Figure 2-32: PowerBook I/O Port Pinouts

Other Systems

The Data Storage System

Later model PowerBook computers contain an internal ATA (IDE) hard drive. IDE hard drives were introduced with the PowerBook 150. Earlier models (up to the 540c) used an internal SCSI hard drive.

You can use the HDI-30 SCSI port or the expansion bay to add external SCSI storage devices.

The Cooling System

Most PowerBook computers dissipate heat through their bottom or top surfaces. It is important not to obstruct air flow over these surfaces while the computer is on.

The following features of PowerBook computers also help to dissipate heat:

- Elevation feet – Most PowerBook models include elevation feet. The feet should always be extended when the computer is on, to ensure that air can circulate underneath the base to cool the computer.
- Fan – The PowerBook 3400, G3, and G3 Series computers include an internal fan. The fan is activated automatically when needed.

PowerBook Boards and Cards

All PowerBook computers contain a logic board (motherboard). The functions of the logic board differ from model to model, depending on whether other boards are present. An inverter board is also present in all PowerBook models, although it may not be replaceable separately from the display assembly.

Table 2-2 shows the replaceable boards and cards (other than the logic board) in existing PowerBook models.

Table 2-2: PowerBook Boards and Cards

PowerBook Model	Daughter-board	Cousin Card	Inverter Board	Converter Board	Intercon-nect Board	Power Supply Board/ Card	PMU Card	Video Board/ Card
100	X		X		X			
140/145/145 B/170	X		X		X			
150			X		X			
160, 165, 180	X		X		X			
165c, 180c	X	X	X	X	X			
190 series			X					X
200 series			X*					
500 series	X		X		X			
1400 series	X		X					X
2300c			X					
2400	X		X			X		
3400 series			X			X		
5300 series			X			X		X
G3			X			X		
G3 Series	X		X			X	X	

*The inverter board is considered part of the display assembly on the PowerBook 210, 230, 250, and 280 computers. On the 270c and 280c, the inverter board is a separate module.

Functions/Components by Board and Model

Table 2-3 shows the major functions of and components on (and identifies which board contains them) various PowerBook computers.

Note — The PowerBook G3 and PowerBook G3 Series are different computers. The PowerBook G3 has the same case and hardware design as the PowerBook 3400 series, while the PowerBook G3 Series computers have a newer case and hardware design and different features (see Figure 1-1 and Figure 2-1). The only commonality between them is that both PowerBook G3 and PowerBook G3 Series computers are based on the PowerPC G3 microprocessor.

Table 2-3: Functions/Components by Board and Model

Component or Function	Logic (Mother) Board	Daughter-board	Cousin Card	Inverter Board	Converter Board	Intercon-nect Board	PMU Board	Video Board
CPU, Math coprocessor (if present)	150, 190, 200, 2300, 5300, 3400, G3	100 series (except 150 & 190), 500, 1400, G3 Series						
System RAM, ROM	190, 200, 1400, 2300, 2400, 5300, 3400, G3	100 series (except 165c, 180c, 190), 500 series, G3 Series	165c, 180c					
RAM expansion slot	190, 200, 1400, 2300, 2400, 5300, 3400, G3	100 series (except 190), 500 series, G3 Series						
VRAM	190, Duo series, 2400, 5300, 3400, G3, G3 Series	100 series						
External video VRAM								190, 1400 (option), 5300
PRAM	All							
Power management unit	All except G3 Series						G3 Series	

Table 2-3: Functions/Components by Board and Model

Component or Function	Logic (Mother) Board	Daughter-board	Cousin Card	Inverter Board	Converter Board	Intercon-nect Board	PMU Board	Video Board
Provide AC voltage to display backlight				All				
Change 5V DC to 12V DC for display					165c, 180c			
Provides voltage to inverter board	190, 1400, 2400, 3400, 5300, G3, G3 Series					100 series, 500 series		
Refreshes display, sends data/controls to display	150, 190, 200 series, 2300, 2400, 5300, G3, G3 Series	100 series (except 150 & 190), 500, 1400						
Contains keyboard controller	100 series, 200, 2300, 500, 1400, 2400, 5300, G3 Series							
Routes signals from keyboard	190,5300, Duo series, 2400, 3400, G3, G3 Series					100 series, 500 series		
Floppy drive connector	All							
Internal SCSI connector	All PBs that contain internal SCSI drive							
Internal Modem PCB connector	Some PBs							
Main battery connector	All except 3400, 5300, G3						3400, 5300, G3	
Audio output	All							
Disk formatting	All							

When you are ready, complete the exercise beginning on the following page.

Exercise 1: Modules

Using your memory, this module, and Service Source, name the hardware module or component usually responsible for the function or feature listed in the first column.

This function or feature	on this PowerBook model	is most likely found on this hardware module
DC voltage and distribution	1400 Series	
Central processing	100	
Voltage and signal passing between base unit modules and other modules	100 Series	
DC voltage and distribution	G3 Series	
Capacitance sensing and cursor movement	2300c	
SCSI Disk Mode	520c	
Keyboard input interpretation	2400	
Connection to TV	G3 Series	
Data storage	150	
Heat dissipation	1400 Series	
Disk access (ASIC)	5300	
Power supply for display and backlight	200 Series	
Heat dissipation	G3	

Note — When you are ready, check your work with the answers on the next page.

Exercise 1: Answers

Compare your answers to Exercise 1 with those given below. Then continue with Exercise 2.

This function or feature	on this PowerBook model	is most likely found on this hardware module
DC voltage and distribution	1400 Series	power supply circuitry on logic board
Central processing	100	daughterboard
Voltage and signal passing between base unit modules and other modules	100 Series	interconnect board
DC voltage and distribution	G3 Series	power supply circuitry on power supply board
Capacitance sensing and cursor movement	2300c	trackpad
SCSI Disk Mode	520c	logic board
Keyboard input interpretation	2400	daughterboard
Connection to TV	G3 Series	logic board
Data storage	150	IDE hard drive
Heat dissipation	1400 Series	bottom case and keyboard
Disk access (ASIC)	5300	logic board
Power supply for display and backlight	200 Series	inverter board
Heat dissipation	G3	fan

Exercise 2: Functions

Fill in this table with the missing functions.

Module	Function
PDS connector	
PMU	
Charger board	
Converter board	
Cousin card	
Trackball	

Note — When you are ready, check your work with the answers on the next page.

Exercise 2: Answers

Compare your answers to Exercise 2 with those given below. Then continue with Exercise 3.

Module	Function
PDS connector	Provides expansion options
PMU	Controls aspects of the power system
Charger board	Controls charging of the battery (G3 Series)
Converter board	Converts 5 VDC to 12 VDC for the inverter board
Cousin card	Holds system RAM and ROM (165c and 180c)
Trackball	Controls cursor movement

Exercise 3: Troubleshooting

Answer the following questions in the space provided. Try to respond from memory using what you have just learned about PowerBook computer technology. If you need assistance, review this module.

1. A user complains he cannot shut down his PowerBook computer; every time he tries the computer immediately restarts without him pressing the power key. What is the most likely problem?

   ____

2. An experienced user brings in a PowerBook computer for repair because the PowerBook computer exhibits no video, no sound, no activity of any kind, despite the user having tried two different power adapters and a fresh set of batteries. What is the first component you should check for failure?

   ____

3. A user brings in a PowerBook G3 series computer with a DSTN display for repair because there is a faint horizontal line right across the middle of the screen. Which module is most likely faulty?

   ____

4. A customer brings in a PowerBook 520 for repair because the display does not work, there is no image at all. Which module or component is most likely at fault?

   ____

5. You are servicing a PowerBook 280c and you notice you cannot adjust the brightness on the display. Which module should you check first, since it is the most likely faulty one?

   ____

6. A customer brings in a PowerBook 180c because the screen has a half-inch horizontal section where the display is dark. Which module is most likely faulty?

   ____

7. A user has a PowerBook Duo 2300 with an Apple Express Modem. He calls because he cannot print from his PowerBook 2300 to his StyleWriter II. He gets a “printer not found” error, even though he knows the printer is in good working order, it

is turned on, the correct drivers are installed, and the serial cable between the computer and the printer is good. What is one of the first things you should have the user check?

____

8. A user brings in a PowerBook 1400cs because it does not work reliably with her Iomega Zip drive. Half the time when she attempts to save a file to a Zip disk, her PowerBook computer crashes or freezes. She has hooked up the Zip drive to her desktop and has no trouble saving files to the Zip disk. What should you check for on the PowerBook 1400?

____

9. What is an easy way to distinguish between a PowerBook G3 computer and a PowerBook G3 Series computer? From a troubleshooting perspective, why is it important to be able to distinguish between these two computers?

____
____
____
____

Note — When you are ready, check your work with the answers on the next page.

Exercise 3: Answers

Compare your answers to Exercise 3 with those given below.

1. A user complains he cannot shut down his PowerBook computer; every time he tries the computer immediately restarts without him pressing the power key. What is the most likely problem?

   The power management software is mostly likely corrupt. Check if the user is plugging in the power adapter to the PowerBook computer before plugging it into the electrical outlet.

2. An experienced user brings in a PowerBook computer for repair because the PowerBook computer exhibits no video, no sound, no activity of any kind, despite the user having tried two different power adapters and a fresh set of batteries. What is the first component you should check for failure?

   The power supply circuitry.

3. A user brings in a PowerBook G3 series computer with a DSTN display for repair because there is a faint horizontal line right across the middle of the screen. Which module is most likely faulty?

   None. The horizontal line is normal in the DSTN display.

4. A customer brings in a PowerBook 520 for repair because the display does not work, there is no image at all. Which module or component is most likely at fault?

   The cable between the logic board and the interconnect board is the most likely cause, but the interconnect board is also a possibility.

5. You are servicing a PowerBook 280c and you notice you cannot adjust the brightness on the display. Which module should you check first, since it is the most likely faulty one?

   The inverter board.

6. A customer brings in a PowerBook 180c because the screen has a half-inch horizontal section where the display is dark. Which module is most likely faulty?

   The LCD panel.

7. A user has a PowerBook Duo 2300 with an Apple Express Modem. He calls because he cannot print from his PowerBook 2300 to his StyleWriter II. He gets a “printer not found” error,

even though he knows the printer is in good working order, it is turned on, the correct drivers are installed, and the serial cable between the computer and the printer is good. What is one of the first things you should have the user check?

Have the user check that the modem port, not the printer port, is selected in the Chooser. Also check that the modem setting (in the Modem control panel) is set to “normal.”

8. A user brings in a PowerBook 1400cs because it does not work reliably with her Iomega Zip drive. Half the time when she attempts to save a file to a Zip disk, her PowerBook computer crashes or freezes. She has hooked up the Zip drive to her desktop and has no trouble saving files to the Zip disk. What should you check for on the PowerBook 1400?

   Check that the Slow SCSI Extension is installed and working.

9. What is an easy way to distinguish between a PowerBook G3 computer and a PowerBook G3 Series computer? From a troubleshooting perspective, why is it important to be able to distinguish between these two computers?

   The PowerBook G3 computer has the same case as the PowerBook 3400 Series computers, while the PowerBook G3 Series computers have a different case. It is important to be able to distinguish between the two because major functions are handled by different modules on the two different types of computer. For example, the CPU, system RAM, and ROM are on the logic board in the PowerBook G3 computer, but on the daughterboard in the PowerBook G3 Series computers. The PowerBook G3 is NOT part of the PowerBook GE Series computers.

Modem Terminology and Modem Types 3

Modems for PowerBook computers come in a variety of forms: internal, external, and PC-cards. This module will familiarize you with these three types of modems and with basic modem terminology.

What You Will Learn

When you finish this module, you will be able to identify the three types of PowerBook modems and to define basic modem-related terms.

The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module.

Required Materials and Equipment

This module

A pen or pencil

Time to Complete This Module

This module should take approximately 30 minutes to complete.

Skills Checklist

If you think you already possess the following skills, go directly to the module test. If you pass the test, congratulations! Go on to the next module. If you don't pass the test, complete this module before proceeding.

______ • Define the following terms:

- Handshaking
- Negotiation
- bps (“Baud rate”)
- Error control
- Data compression
- AT command set
- Wake on ring
- CCL script

______ • Identify the three types of PowerBook modems.

Modem Terminology

Servicing a modem often requires verifying that appropriate settings have been established. In this section of the module, you learn the function of the major settings common to all modems. This section does not, however, review specific modems or modem applications.

What Is a Modem?

Information inside a computer is in digital format—all the data is stored as a 1 or a 0. In contrast, normal phone lines are analog—they transmit data as a series of continuous waves. A modem is a MOdulator / DEModulator—it modulates outgoing data from digital to analog, and demodulates incoming data from analog to digital.

Handshaking

Handshaking refers to the method used to control the flow of data between the computer and the modem or between two modems. For example, when a modem is ready to receive data or wants the flow of data to stop, the modem needs to communicate that information to the other device.

In hardware handshaking, the hardware (modem and computer) controls the flow of data. In software handshaking, the communications software (for example, using XON / XOFF) controls the flow of data.

Modems of 9600 bps or faster require hardware handshaking cables, which route handshaking signals from the Macintosh serial port to the proper pins on the modem.

Negotiation

When two computers are connected through their modems, the modems must first reach agreement on basic communication settings such as transmission speed, error control, and data compression. The exchange of signals that enables them to reach agreement on these settings is called negotiation.

For example, initially, a modem tries to connect to a remote modem at its highest speed. If one of the modems cannot connect at that speed, both modems fall back to the next highest speed. Fallback continues until the two modems agree on their capabilities.

bps (Baud Rate)

Modem speed is measured as the number of data bits per second (bps) that the modem can receive or send. Most modems are now rated in Kbps (kilobits per second, that is, thousands of bits per second). Many people, and even some application programs, mistakenly use the term baud rate to mean bps.

Strictly speaking, baud rate means “the number of analog signal state changes per second.” One baud is properly defined as “one change of state in an analog signal.” One baud may transmit more than one bit of data. However, in common usage, baud rate is almost always used to mean the speed of the modem, measured in bps.

Most modems currently being sold operate at 14.4 Kbps (14,400 bps), 28.8 Kbps, 33.6 Kbps, or 56 Kbps (see A Note on 56 Kbps Modem Technology, below).

Speed Setting

You may notice that the bps speed of the modem is sometimes not available as a choice in the Speed setup area of the communications application you are using. In many applications, the Speed setting actually refers to the speed of data transmission between the computer and the modem, NOT the bps between your modem and a remote modem.

In most cases, it is to your advantage to select the highest available speed of transmission between the computer and the modem.

A Note on 56 Kbps Modem Technology

Users of 56K modems may complain that their modems never actually achieve a communication speed of 56 Kbps. In most cases, this does not indicate any problem with the modem.

Data transmission speed depends on three factors:

- The speed of the user's modem
- The speed supported by the Internet Service Provider (ISP)
- The type of phone lines between the user and the ISP

Although the telephone system is gradually converting to digital phone lines, most phone lines are still analog. The analog phone line is the most important limiting factor on data transmission speed, because of the inherent noise it contributes. Up to now, the maximum speed of modems has been limited to 33.6 Kbps because of the limits of analog phone lines.

56K modems are made possible by the spread of digital phone lines and by new techniques that treat the phone system as a mostly digital network. However, for 56K technology to work, you can only have one analog-to-digital conversion between your home or office and the ISP. If there's more than one, the modem cannot use 56K technology, and your connection will be limited to a maximum of 28.8 or 33.6 Kbps.

Even with digital phone lines, most users of 56K modems currently achieve actual communication speeds of 40 to 50 Kbps at best. And even if there were no technical limitations, a true 56K connection would remain unattainable—because the FCC (Federal Communications Commission) currently limits 56K modems to a maximum speed of 53 Kbps when used within the United States!

It is also important to understand that 56 Kbps is the optimum rate at which a 56K modem can RECEIVE data; its transmission speed is usually limited to 33.6 Kbps because of current technology.

Error Control

Error control is a method of checking data for errors. The PowerBook computer modem and the remote modem must agree on an error control method. Examples of error control protocols include V.42 and MNP class 2-4.

Data Compression

Data compression increases modem speed by eliminating gaps and redundancies from the data. With data compression enabled, data can be sent at up to four times the noncompression speed. Examples of data compression protocols include V.42 bis or MNP class 5. Both modems must support the same data compression protocol, or data compression cannot be used.

AT Command Set

The AT command set is a command language that you can use to control modem parameters such as bps, error control, and data compression. Typically, these parameters are set by means of a CCL file (see CCL Files, below) or modem profile supplied by the Internet Service Provider. However, if you need to set the parameters manually for testing or other purposes, the AT command set can be a valuable tool.

“AT” (short for “ATtention sequence”) refers to the prefix that precedes each command to the modem. To use the AT command set, you need a terminal emulation program, such as ZTerm or the Communication module of ClarisWorks, which allows you to type in and send the commands. For more information, see the user's manuals for the modem and the terminal emulation program you are using.

CCL Files

A Connection Control Language (CCL) script, or CCL file, is a file that contains the AT commands needed for the computer to configure a particular modem for a specific application.

CCL scripts often reside in the Extensions folder or in a Modem Scripts folder within the Extensions folder. (Some third-party applications may use other locations for CCL files.)

The user must select the appropriate CCL file for the modem being used. The method of choosing the CCL file depends on the application. For instance, if you are using Open Transport PPP, you select the CCL file in the Modem control panel. If you are using other applications, modem CCL selection is usually part of the setup options.

If the appropriate modem does not appear in the setup or Modem menu(s), the CCL file may be missing or misplaced. A generic (sometimes labeled Hayes-compatible) CCL file can often be used until the correct CCL file can be obtained.

Wake on Ring

Wake on Ring is a feature of some PowerBook computers with internal modems. When this feature is activated, the computer automatically wakes from sleep when the internal modem receives a phone cal. (Without this feature, incoming calls are not received when the computer is in sleep mode.)

PowerBook 100 series computers (except the 150 and 190) support the Wake on Ring feature. In the PowerBook 100, 140, 145, 145B, 160, 165, 165c, 170, 180, and 180c computers, Wake on Ring is activated through the PowerBook (sometimes called Portable) control panel and / or the Modem control panel.

PowerBook 500 series computers equipped with an internal Global Village PowerPort Mercury modem also support Wake on Ring. In these computers, Wake on Ring is activated through the PowerPort control panel.

Note — When you are ready, complete the exercise beginning on the next page.

Exercise 1: Modem Terminology

Respond to the items below. Try to respond from memory. If you need assistance, review the “Modem Terminology” section of this module.

1. Define the term handshaking as it relates to modem operation.

2. Briefly define the following:

   a. Negotiation

   b. bps (baud rate)

   c. Error control

   d. Data compression

   e. AT command set

f. CCL file

____

____

____

g. Wake on Ring

____

____

____

Note — When you are finished, compare your answers to those on the following page.

Exercise 1: Answers

Compare your answers to the exercise with those given below.

1. Define the term handshaking as it relates to modem operation.

   Handshaking refers to the method used to control the flow of data between the computer and the modem, or between two modems. For example, when a modem is ready to receive data, or wants the flow of data to stop, the modem needs to communicate that information to the other device.

   In hardware handshaking, the hardware (modem and computer) controls the flow of data. In software handshaking, the communications software (for example, using XON / XOFF) controls the flow of data.

2. Briefly define the following:

   a. Negotiation

   When two computers connect through their modems, the modems must first reach agreement on basic communication settings such as baud rate, error control, and data compression. The exchange of signals that enables them to reach agreement is called negotiation.

   b. bps (baud rate)

   Modem speed is measured as the number of data bits per second (bps) that the modem can receive or send. Many people, and even some application programs, mistakenly use the term “baud rate” to mean “bps.”

   c. Error control

   Error control is a method used by modems to check data for errors. The PowerBook computer modem and the remote modem must agree on an error control method.

   d. Data compression

   Data compression is a way of increasing data transfer speed by eliminating gaps and redundancies from the data.

   e. AT command set

   A command language commonly used to manually alter modem settings through software.

f. CCL file

A Connection Control Language (CCL) script, or CCL file, is a file that contains the AT commands needed for the computer to configure a particular modem for a specific application.

CCL scripts often reside in the Extensions folder or in a Modem Scripts folder within the Extensions folder. (Some third-party applications may use other locations for CCL files.)

g. Wake on Ring

When available and selected, this option wakes a PowerBook computer from sleep mode to receive incoming calls.

If you missed more than two items, please review this section of the module before continuing.

Note — When you are finished, continue with the next section.

Types of PowerBook Modems

PowerBook computers can use any of three types of modem:

- Internal modem
- External modem
- PC Card modem

This section briefly describes these types of modem.

Internal Modem

An internal modem is either a standard feature or an option on most PowerBook computers. The internal modem is a card that connects to the logic board. The PowerBook computer contains a standard phone jack opening for the modem card connector. The phone line plugs directly into the modem connector. (In non-U.S. locations, a different connector may be used.)

Some PowerBook models support an internal Ethernet / Modem card. This card has an RJ-45 connector. To connect to both an Ethernet network and a phone line, you must attach a Y-connector to the RJ-45 connector. The Y-connector has an RJ-11 connector for the phone line and an RJ-45 connector for the Ethernet cable.

Troubleshooting Note — Some PowerBook models support the Apple Express Modem. This is a software modem, so when troubleshooting, follow the procedures for software troubleshooting, and be sure to have the appropriate version of Apple Telecom installed.

External Modem

A standard external modem can be connected to any PowerBook computer with one or more serial ports. The external modem connects to the PowerBook serial port.

PC Card Modem

Many manufacturers now produce modems in the compact PC Card (PCMCIA card) format. The PC card fits into one of the two PC-card slots on PowerBook computers with PC card support. The phone line plugs into a port on the card or into an adapter cable connected to the card.

Exercise 2: Types of PowerBook Modems

Name, and briefly describe, the three types of modems available for PowerBook computers:

Note — When you are finished, compare your answers to those on the following page.

Exercise 2: Answers

Name, and briefly describe, the three types of modems available for PowerBook computers:

1. Internal modem – a card that attaches to the PowerBook logic board.
2. External modem – a standalone modem that attaches to the PowerBook serial port.
3. PC Card modem – a modem in the compact PC card (PCMCIA card) format.

Power Management 4

Understanding power management features is essential to operating and servicing PowerBook computers. In this module, you learn the function and operation of PowerBook computer power management features.

What You Will Learn

When you finish this module, you will be able to identify and use power management features. The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module.

Required Materials and Equipment

This module requires the following materials and equipment:

- PowerBook computer with System 7.1.1 or later
- Apple *Service Source* CD (April 1998 version or later)
- Macintosh computer for use with *Service Source* CD (for hardware platform requirements, see the *Service Source* CD booklet)

Time to Complete This Module

This module should take approximately 2.5 hours to complete.

Skills Checklist

If you think you already possess the following skills, go to Exercise 1, Exercise 2, and the module test. If you complete the exercises and the test without missing more than two questions, go on to the next module. If you miss more than two questions, complete this module before you proceed.

______ • Describe the following power modes and indicate how to initiate each:
  - Awake
  - Sleep
  - Shut down

______ • Identify and describe the following power management features found in system software versions prior to 7.1.1, and indicate how to use each feature:
  - Battery desk accessory
  - PowerBook control panel

______ • Identify and describe the following power management features found in system software versions 7.1.1 and later, and indicate how to use each feature:
  - Control Strip
  - PowerBook control panel

______ • Identify and indicate the use of the Control Strip control panel.

______ • Identify and describe the following power management features found in the PowerBook G3 Series computers, and indicate how to use each feature:
  - Energy Saver control panel
  - Energy Saver control strip module

______ • Identify low-power warning messages and symptoms, and indicate the appropriate action to take in response to them.

______ • Identify safe handling procedures for PowerBook batteries.

______ • Identify procedures for recharging and extending the life of specific battery types, with and without a battery recharger.

______ • Identify proper disposal procedures for PowerBook batteries.

______ • Indicate where the procedures for battery and battery recharger verification are located on *Service Source* CD.

Power Management Features

All PowerBook computers can be powered either by a battery or by a power adapter. A variety of features programmed into the system software allow the user to monitor the charge level of the main battery and to control the computer's power usage. How these power management features are used determines how long the computer can be used between rechargings. How the user manages these power management features can also affect the battery's longevity — how long the battery will last before it needs to be replaced.

Different versions of the Mac OS have included different power management options and features. To ensure a comprehensive understanding of power management options and features, we will first review system software versions below 7.1.1, followed by versions 7.1.1 and later, and then by Mac OS 8.1 for the PowerBook G3 Series, which introduces some new features.

As you review the power management features discussed in this module, take time to locate and use the corresponding features on your PowerBook computer.

Power Modes

All PowerBook computers have three power modes:

- Awake – computer is fully functional and ready to be used.
- Sleep – computer is fully functional but in a resting state. The computer appears to be shut down but is actually operating at a reduced power level to conserve battery charge.
- Shut Down – computer is powered off and must be restarted to become functional.

Sleep Mode

There are several ways to put a PowerBook computer into Sleep mode:

- Select the Sleep command in the Special menu (available in all Mac OS versions).
- Select Sleep from the Control Strip (System 7.1.1 and later)
- Press the power key for two seconds and choose Sleep from the dialog box that appears (available in PowerBook models that have a power key)
- Activate the sleep switch by closing the PowerBook case (more recent models)

System software automatically places the computer into sleep mode after a certain period of inactivity. You can specify this period in a control panel (described later in this module). However, the computer will not automatically go into sleep mode if any of the following conditions are true:

- AppleTalk is turned on in the Chooser and the power adapter is plugged in.
- The computer is connected to a shared disk on the network.
- The computer's printer or modem port is in use.
- Sleep is set to "Never" in the control panel.

In addition, the PowerBook 200 Series computers will not go into sleep mode when they are docked in a DuoDock (but can go into sleep mode whey they are connected to a MiniDock or a floppy adapter.

To wake any PowerBook computer from sleep, press any key (except Caps Lock).

System Software Versions Prior to 7.1.1

Power management options and features in system software versions prior to 7.1.1 are found in the

- Battery desk accessory
- PowerBook control panel

Battery Desk Accessory

To open the Battery desk accessory, select Battery from the Apple menu (see Figure 4-1).

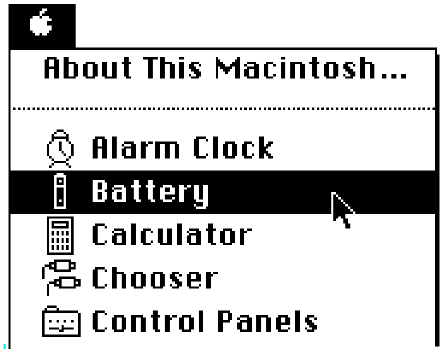


Figure 4-1: Selecting the Battery Desk Accessory

The line of rectangles (Figure 4-2) is the battery gauge. Black rectangles indicate the charge level. You can see the charge level decrease while the battery is in use and increase while the battery is recharging in the computer. When you click the lever in the upper-right corner of the battery gauge, a Sleep button appears. You may find it convenient to put the computer to sleep by clicking this button instead of choosing the Sleep command in the Special menu.

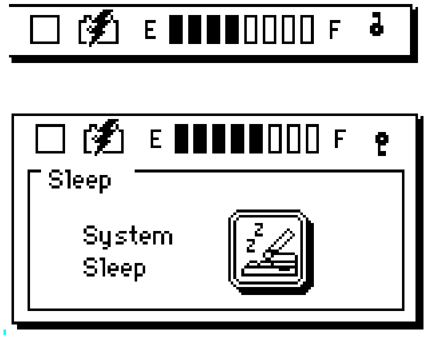


Figure 4-2: Battery Desk Accessory With Sleep Button Hidden or Shown

PowerBook Control Panel

The PowerBook control panel allows you to regulate the computer's power consumption by selecting the battery conservation setting along a scale from maximum performance to maximum battery conservation (Figure 4-3).

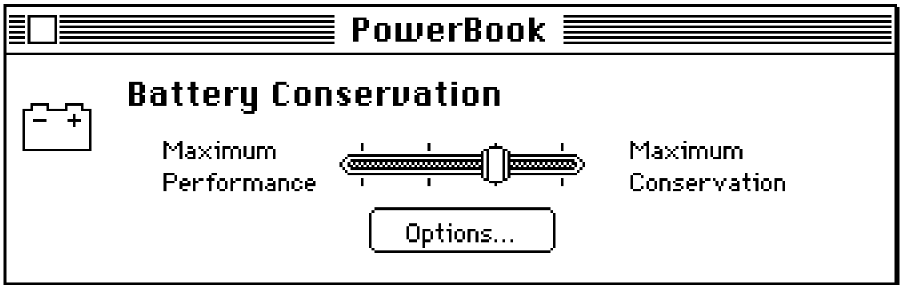


Figure 4-3: PowerBook Control Panel

Note — Some versions of the PowerBook control panel look somewhat different from the one illustrated in Figure 4-3 but function in the same manner. In addition, some versions use the control panel name Portable instead of PowerBook.

Use the battery conservation slider on the PowerBook control panel to choose the setting you prefer. The slider has four settings. Each setting determines how long the system and hard drive will operate, while not being used, before being automatically placed in sleep mode (Figure 4-4).

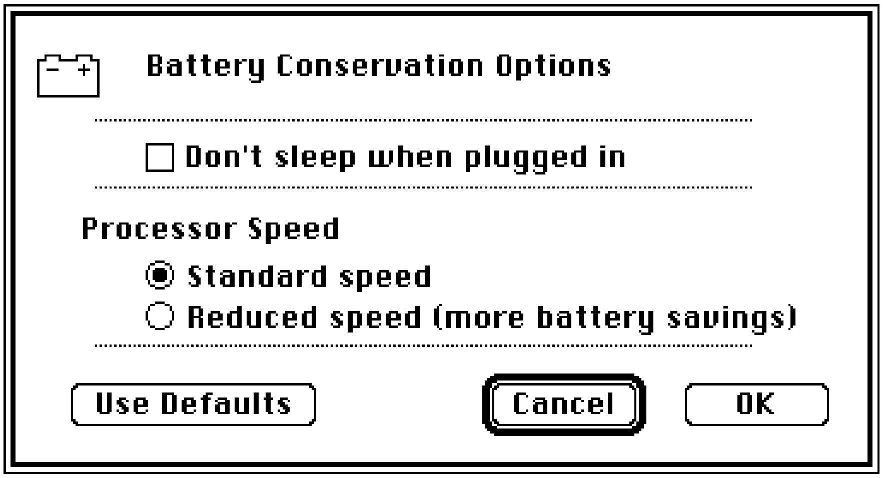
	Maximum Performance	Second Setting	Third Setting	Maximum Conservation
System	15 min.	8 min.	4 min.	1 min.
Hard Drive	15 min.	4 min.	2 min.	0.5 min.

Figure 4-4: Battery Conservation Settings

When you change the Battery Conservation setting, the change takes place immediately.

Battery Conservation Options

The Battery Conservation window of the PowerBook control panel includes a button labeled *Options*. Click this button to see more options for regulating power consumption (Figure 4-5).



Battery Conservation Options

☐ Don't sleep when plugged in

Processor Speed

● Standard speed

○ Reduced speed (more battery savings)

Figure 4-5: Battery Conservation Options

If the power adapter is plugged in, you can prevent automatic sleep by clicking “Don’t sleep when plugged in.”

The processor speed selection (Figure 4-5) allows you to decrease the computer’s microprocessor speed. Some programs may work more slowly, but you may gain up to 15-20 minutes of work time before you need to recharge the battery. (The amount of time you gain depends on how you are using the computer.)

To decrease the processor speed, follow these steps (Figure 4-5):

1. Open the Battery Conservation window.
2. Click “Reduced speed.”
3. Click OK.
4. Choose Restart from the Special menu.

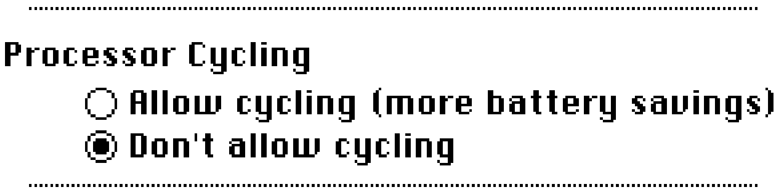
The computer runs at the lower microprocessor speed until you click “Standard speed” and restart the computer again.

Processor Cycling

Processor cycling reduces the power consumption of the microprocessor by reducing its speed when it is not in use. The microprocessor comes back up to speed instantaneously when you resume work. Processor cycling is the default setting; you do not have to select it. But if you notice that one of your programs performs very slowly, you might want to turn off processor cycling while you use that program.

To turn off processor cycling, follow these steps:

1. Open the PowerBook control panel.
2. Hold down the Option key on your keyboard and click the Options button. (If the computer is running System 7.1, you don’t need to hold down the Option key.)
3. Click “Don’t allow cycling”(Figure 4-6).



Processor Cycling

○ Allow cycling (more battery savings)

● Don't allow cycling

Figure 4-6: Processor Cycling Option

4. Close the PowerBook control panel.

To turn processor cycling back on, click “Allow cycling.”

Besides slow response time, you may notice other effects of processor cycling. For example, if you have open programs doing something in the background, processor cycling may slow those programs down. You may also notice that the Alarm Clock is updated irregularly or that the wristwatch pointer appears often. These effects do not indicate a problem with your computer. To conserve battery power, leave processor cycling on as much as possible. Turn processor cycling off only when it interferes with program operation.

When you turn processor cycling off, the computer drains the battery faster. The computer may also become very warm to the touch, especially on the bottom of the computer beneath the keyboard. These effects do not indicate a problem with your computer.

System Software Versions 7.1.1 and Later

Several new power management features were added to system software beginning with version 7.1.1. These new features include the following items:

- Control Strip control panel
- An expanded PowerBook control panel

Control Strip

The Control Strip replaces the Battery desk accessory found in earlier versions of system software. The Control Strip (Figure 4-7) appears at the bottom of the display and provides easy, direct access to power management features and frequently used controls.

Each icon in the Control Strip is called a *module*. The modules on the Control Strip work the same way as control panels, but, for the most part, control panels offer more options. The Control Strip gives you easy access to the controls you use most often.

Note — Control Strip modules vary from one PowerBook computer to another, depending on available features.

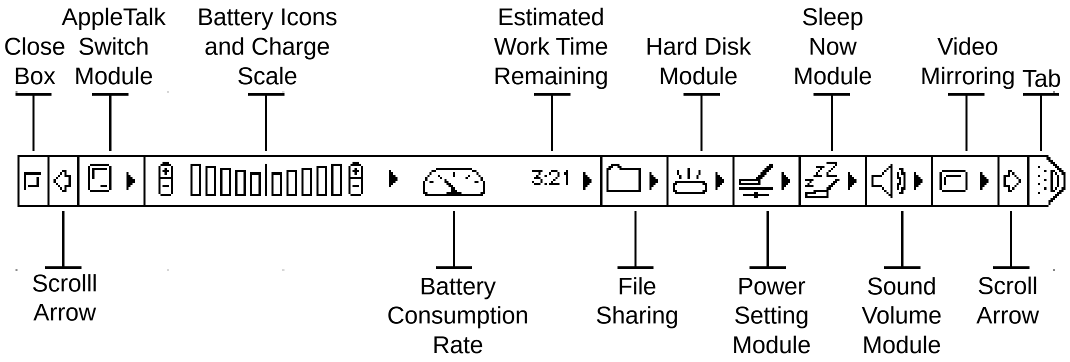


Figure 4-7: PowerBook Control Strip

Use the Control Strip control panel to show or hide the Control Strip.

The Control Strip modules shown in Figure 4-7 are reviewed in the following list:

- The battery module (Figure 4-7 and Figure 4-8) allows you to control battery operation, and has four parts:

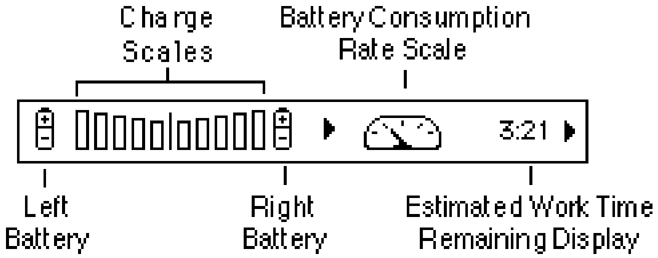

Charge Scales
Battery Consumption Rate Scale
3:21
Left Battery
Right Battery
Estimated Work Time Remaining Display

Figure 4-8: Control Strip Battery Module for Dual Batteries With Smart Battery Features

- Battery icon – A battery icon is displayed for each installed battery pack (one or two depending on the PowerBook computer model). When the computer is powered by battery, positive and negative signs appear on the battery icons, as illustrated in Figure 4-8. When the power adapter is connected to the computer and to a power source, a lightning bolt appears on the battery icons when the batteries are being charged, and a plug appears on the battery icons when the batteries are fully charged.
- Battery charge scale – The Control Strip displays a battery charge scale for each installed battery (Figure 4-8). When a scale is completely dark, the corresponding battery is fully charged. When a scale is partially darkened, the corresponding battery is partially charged.
- Battery consumption rate scale – The rate of total battery consumption is displayed when the computer is powered by battery (Figure 4-8). As you use more components and features, such as activating the AppleTalk network system and accessing the hard drive, the rate of power consumption increases, causing the consumption-rate needle to move towards the right. Activating power saving features, such as hard drive spin-down, causes the needle to move towards the left.
- Estimated work time remaining display – The estimated work time remaining is displayed, in hours and minutes, when the computer is powered by battery (Figure 4-8). Use this time-remaining estimate to gauge how long the computer can be used before you need to recharge the batteries. (This feature is not supported on all PowerBook models.)

The battery charge level, battery consumption rate, and estimated work time remaining fluctuate according to the software, hardware, and power-saving features in use. The battery consumption rate and estimated work time remaining are displayed only when the computer is powered by battery.

- The open/close button (Figure 4-9) allows you to close the Control Strip so that only the tab is visible. When only the Control Strip tab is visible, the open/close button allows you to open the Control Strip.

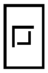


Figure 4-9: Control Strip Open/Close Button

- The AppleTalk switch module allows you to turn the AppleTalk network system on or off. When the AppleTalk network is on, cables are shown coming from the icon, as illustrated in Figure 4-10. When the AppleTalk network is off, the icon is shown without cables.

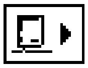


Figure 4-10: Control Strip AppleTalk Switch Module

- The file sharing icon allows you to turn file sharing on or off. When file sharing is turned on, cables are shown coming from the folder, as illustrated in Figure 4-11. When file sharing is turned off, the folder is shown without cables.

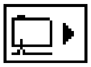


Figure 4-11: Control Strip File Sharing Icon

- The hard disk is one of the main consumers of battery power. To extend work time while using the battery, turn off the hard disk Figure 4-12) when it’s not in use. This is called *spinning down* the hard disk. The hard disk will return to full operation when information stored on the hard disk is required.

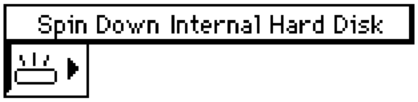


Figure 4-12: Control Strip Hard Disk Module

- The power setting module (Figure 4-13) allows you to control your computer’s power consumption. Selecting “Open PowerBook Control Panel” opens the PowerBook control panel in the Control Panels folder.

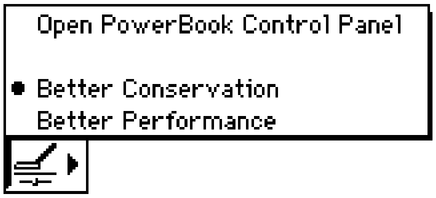


Figure 4-13: Control Strip Power Setting Module

  Selecting the Better Conservation option increases available work time by reducing the amount of time before the system goes to sleep, the hard disk spins down, and the screen dims.

  Selecting the Better Performance option allows you to work with the fewest interruptions by increasing the amount of time before the system goes to sleep, the hard disk spins down, and the screen dims.

- The sleep now module (Figure 4-14) allows you to put the computer to sleep, which is the highest state of conservation. When the computer is in sleep mode, the green sleep-mode LED, found on some PowerBook computers, flashes.

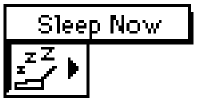


Figure 4-14: Control Strip Sleep Now Module

- The sound volume module (Figure 4-15) allows you to increase or decrease sound volume.

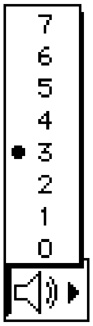


Figure 4-15: Control Strip Sound Volume Module

- The video mirroring icon (Figure 4-16) allows you to display video on a second monitor connected to the computer.

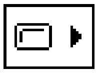


Figure 4-16: Control Strip Video Mirroring Icon

- The Control Strip tab (Figure 4-17) allows you to resize the Control Strip to display more or fewer Control Strip modules. If you depress the Option key on the keyboard while clicking on this tab, you can reposition the Control Strip in any area of the display, attached to either the right or left side of the display.

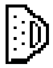


Figure 4-17: Control Strip Tab

PowerBook Control Panel

The PowerBook control panel gives you several ways to control your computer's power consumption, and offers additional features not found on control panels in earlier versions of system software. You can access the PowerBook control panel by selecting Control Panels on the Apple menu or by clicking the Power Settings module on the Control Strip. The PowerBook control panel opens in the Easy option (Figure 4-18).

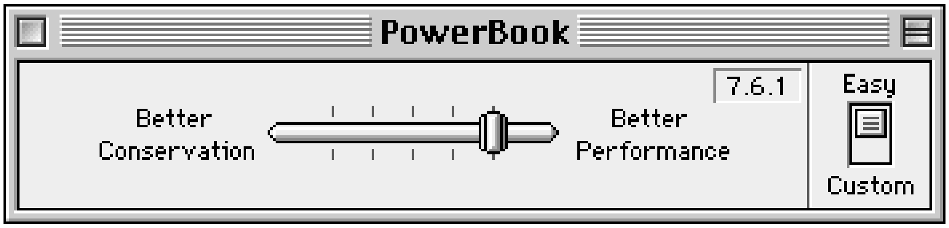


Figure 4-18: PowerBook Control Panel (Easy Option)

The Easy option has five settings (see Figure 4-18 and Figure 4-19). The Better Performance setting gives you the maximum amount of time before the computer is placed in sleep mode, and the Better Conservation setting gives you the least. The Better Performance setting uses the most battery power, and the Better Conservation setting uses the least.

	Better Conservation	Second Setting	Third Setting	Fourth Setting	Better Performance
System	2 min.	3 min.	6 min.	8 min.	15 min.
Hard Drive	1 min.	2 min.	3 min.	6 min.	8 min.
Screen Dims	1 min.	2 min.	3 min.	4 min.	5 min.

Figure 4-19: Easy Option Conservation Settings

To view additional power-conservation options, select the Custom option by clicking the space below the button in the upper-right corner of the control panel (Figure 4-20).

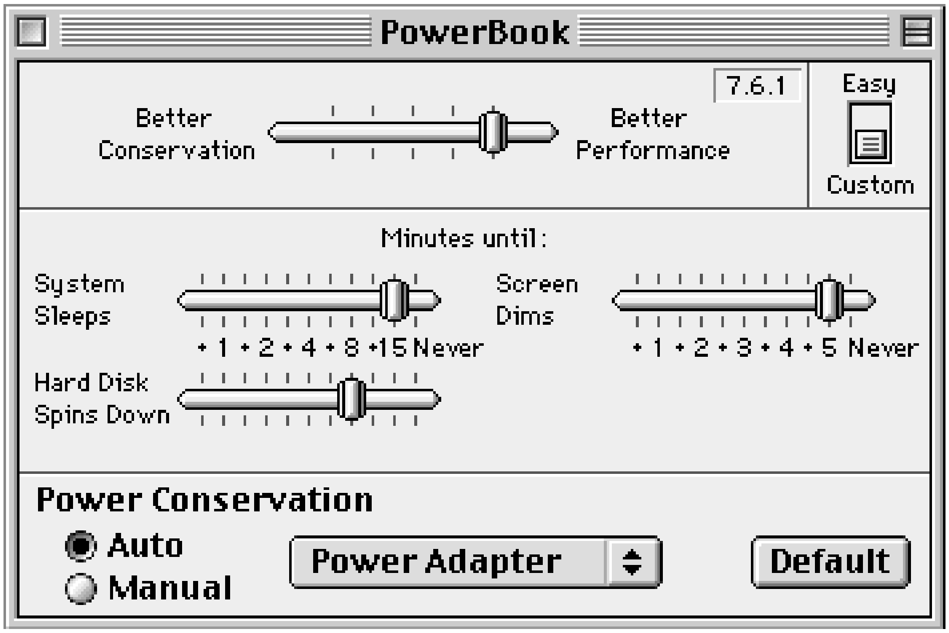
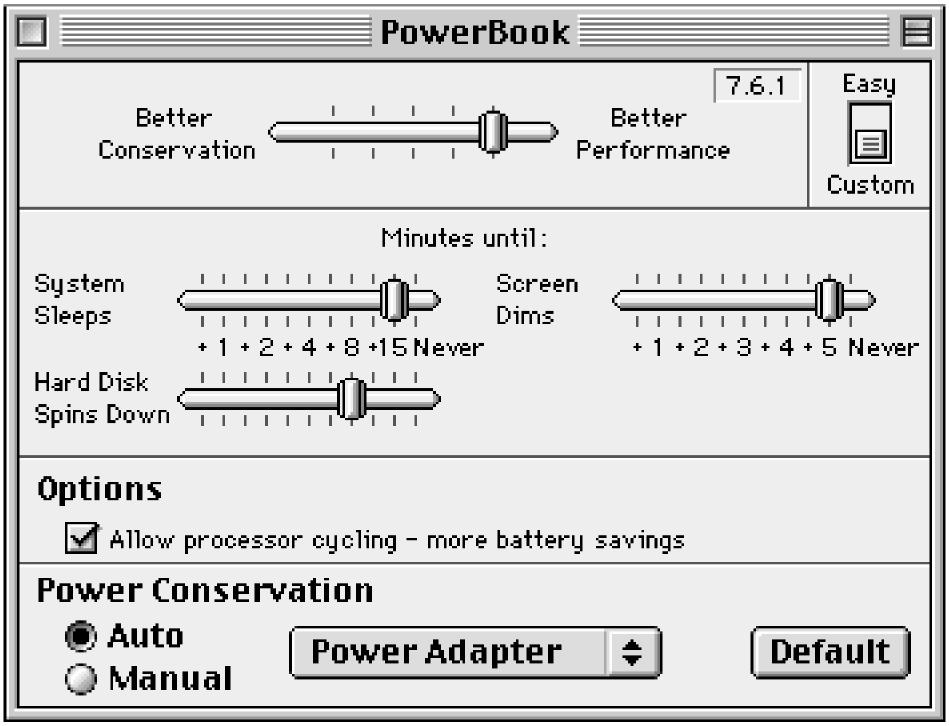


Figure 4-20: PowerBook Control Panel (Custom Option)

The three sliders in the middle of the PowerBook control panel allow you to manually set the minutes of inactivity that elapse before the system, hard drive, and screen are placed in sleep mode.

The Auto option, at the bottom of the PowerBook control panel, allows you to select the settings you desire when using only battery power and when using the power adapter. The settings you select will change automatically when the power adapter is connected and disconnected.

One additional power management feature, processor cycling, is available if you hold down the Option key while you select the Custom option in the PowerBook control panel (Figure 4-21). Just as in earlier versions of system software, if processor cycling is selected, the processor slows down when it is not in use, saving additional energy.



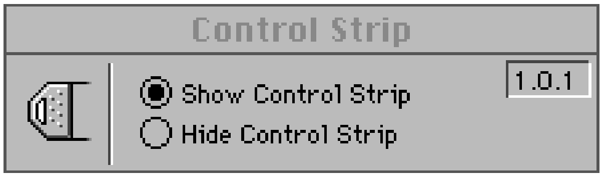
☑ Allow processor cycling – more battery savings

● Auto
○ Manual

Figure 4-21: PowerBook Control Panel in Custom Option with Processor Cycling Option Visible

Control Strip Control Panel

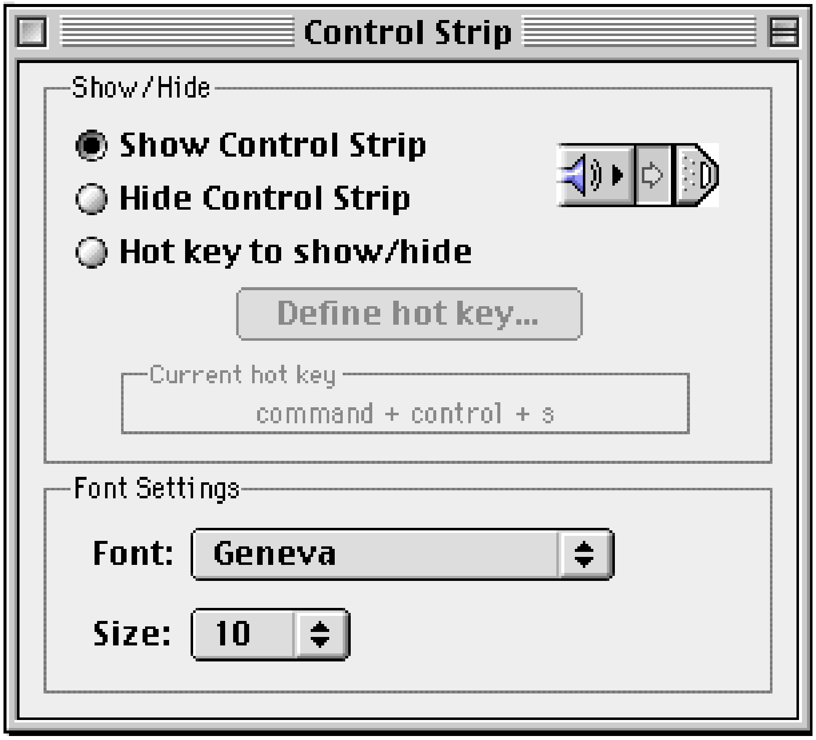
The Control Strip control panel (Figure 4-22) allows the user to hide or show the control strip.



● Show Control Strip
○ Hide Control Strip

Figure 4-22: Control Strip Control Panel, System 7.1.1

In later versions of the Mac OS (Figure 4-23), the Control Strip control panel also allows users to set the type style of the pop-up menus for the control strip modules.



Show/Hide

● Show Control Strip
○ Hide Control Strip
○ Hot key to show/hide

Current hot key
command + control + s

Font Settings

Font: Geneva

Size: 10

Figure 4-23: Control Strip Control Panel, Mac OS 8.1

Troubleshooting Note — If customers complain that they don't see the Control Strip on their PowerBook screen, check that System 7.1.1 or later is installed, then check that "Show Control Strip" is selected in the Control Strip control panel.

PowerBook G3 Series

PowerBook G3 Series computers run on Mac OS 8.1 and come with two new features that impact power management:

- Energy Saver control panel
- Control Strip control panel

Note — The PowerBook G3 and PowerBook G3 Series are different computers. The PowerBook G3 has the same case and hardware design as the PowerBook 3400 series, while the PowerBook G3 Series computers have a newer case and hardware design and different features (see Figure 1-1 and Figure 2-1). The only commonality between them is that both PowerBook G3 and PowerBook G3 Series computers are based on the PowerPC G3 microprocessor.

Energy Saver Control Panel

The Energy Saver control panel replaces the PowerBook and PowerBook Setup control panels. Energy Saver resembles the Energy Star control panel used on desktop Power Macintosh computers.

The upper panel of the main window (Figure 4-24) contains three buttons, which access different windows within the control panel:

- Idle / Sleep
- Scheduled Wake-up and Sleep
- Advanced Settings

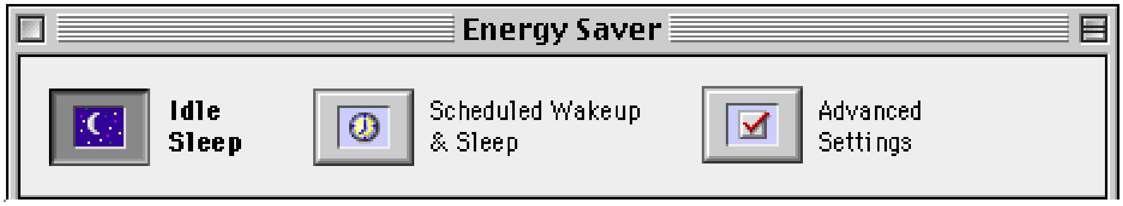
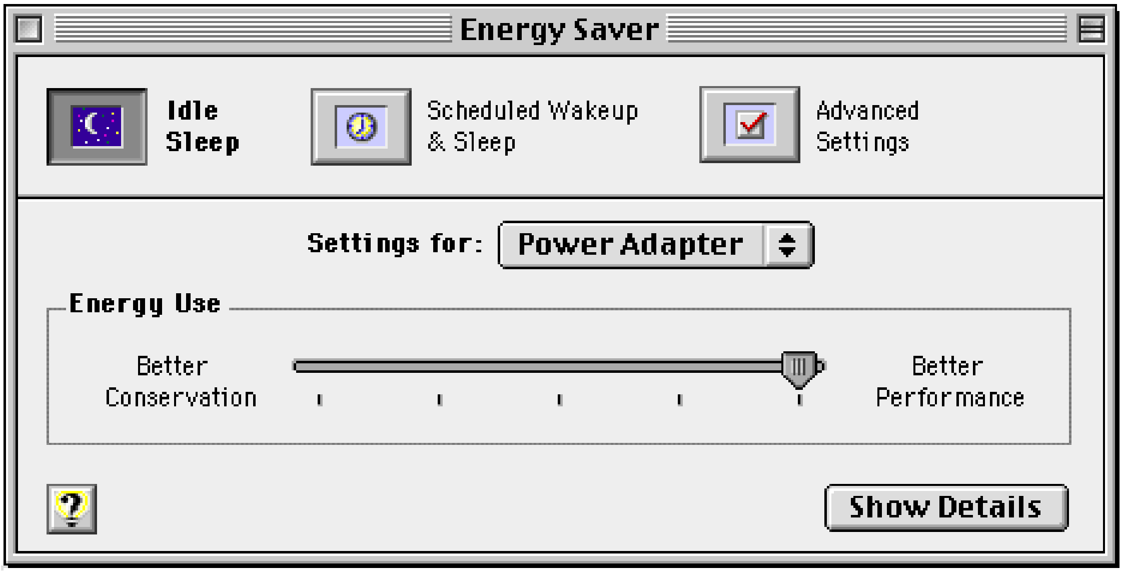


Figure 4-24: Energy Saver Control Panel Buttons

In all three windows, a “Settings for:” pop-up menu allow users to create separate settings for when the PowerBook computer is operated under battery power and when it is using a power adapter. (See Figure 4-25.)



Settings for: Power Adapter

Figure 4-25: Energy Saver Idle/Sleep Window, Simple Mode

Idle and Sleep Settings

By clicking the Idle / Sleep button, you access the window shown in Figure 4-25.

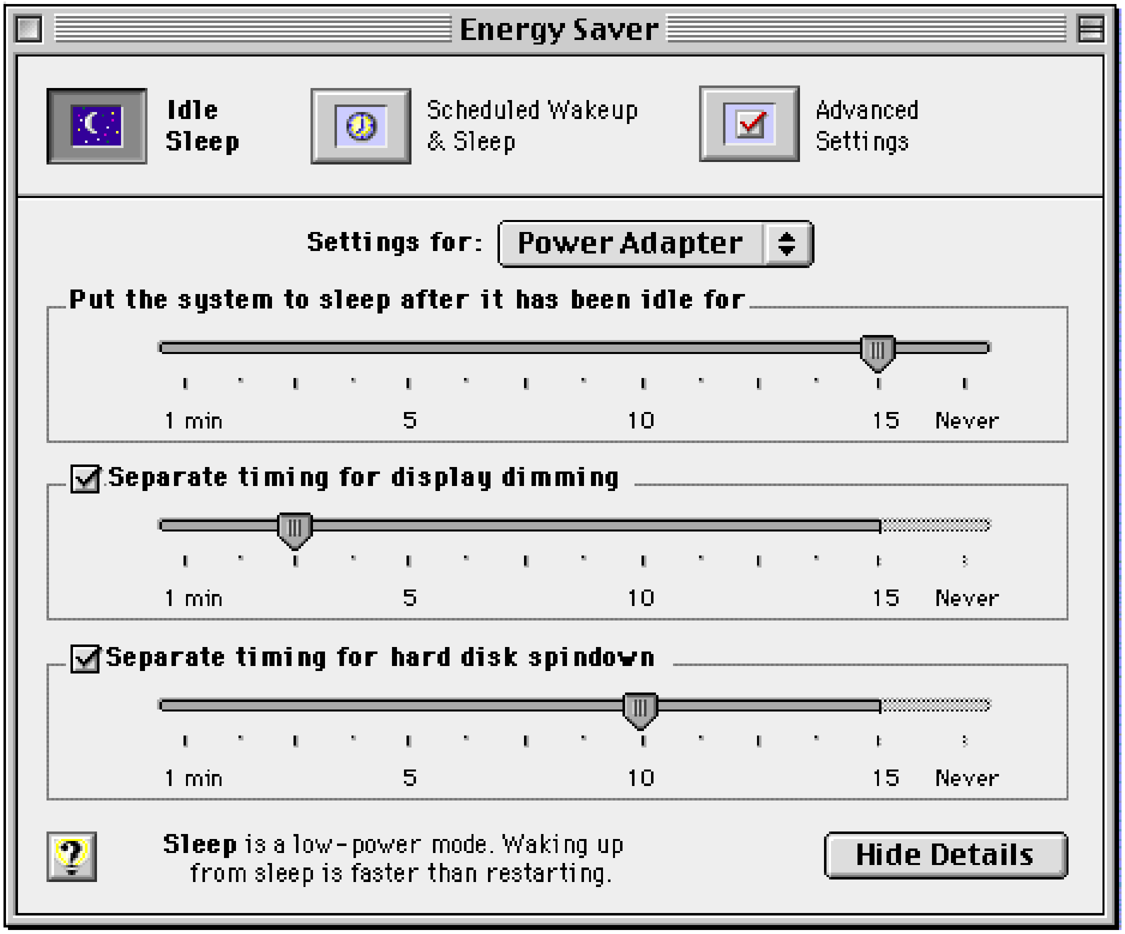
Like the older PowerBook control panel with its Easy and Custom modes, the Idle / Sleep window has two modes, which we can call Simple and Detailed.

- Simple Mode – In Simple mode (Figure 4-25), the user moves a single slider to set Energy Use to some point between “Better Conservation” and “Better Performance.” This slider sets the length of time the system can be idle before the system goes to sleep, the screen dims, and the hard disk spins down. (In Simple mode, all three events take place at the same time.)

  The “Settings for” pop-up menu allows you to choose one energy-use setting for when the PowerBook computer is using its battery and another setting for when the computer is using the power adapter.

  By clicking the Show Details button, the user can access Detailed mode, which is discussed next.
- Detailed Mode – Detailed mode (Figure 4-26) gives the user the option of setting separate timings for sleep, display dimming, and hard disk spindown. For instance, when the two “Separate timing” checkboxes are checked, you can set hard disk spindown to start after two minutes, screen dimming to start after five minutes, and sleep after 15 minutes of non-use.

When neither “Separate timing” checkbox is checked, the main slider determines the settings for all of the options, just as in Simple mode.



Settings for: Power Adapter

Put the system to sleep after it has been idle for
1 min 5 10 15 Never

☑ Separate timing for display dimming
1 min 5 10 15 Never

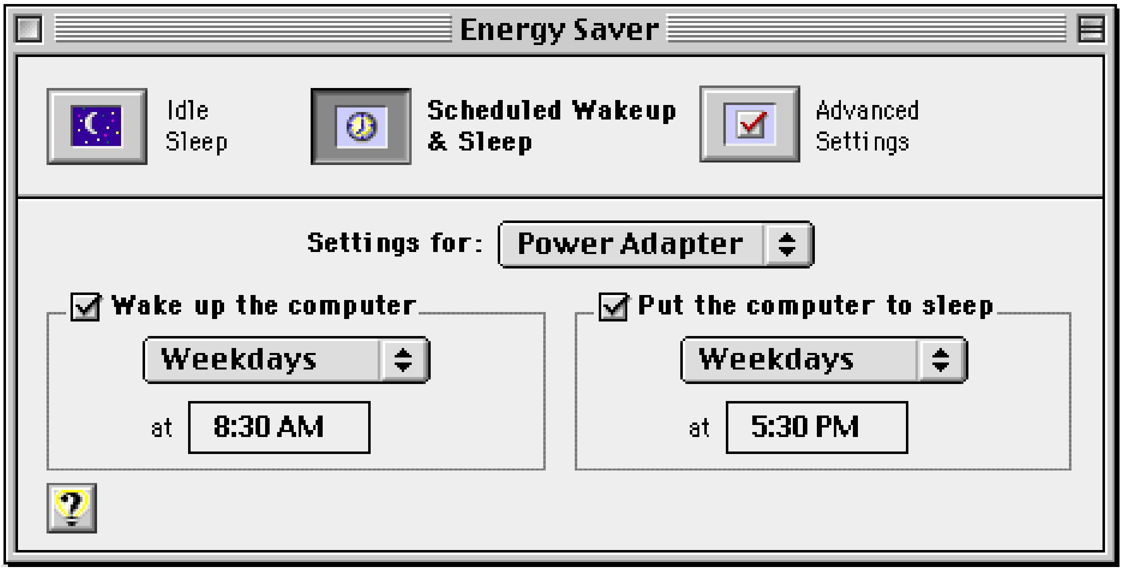
☑ Separate timing for hard disk spindown
1 min 5 10 15 Never

Sleep is a low-power mode. Waking up from sleep is faster than restarting.

Figure 4-26: Energy Saver Idle/Sleep Window, Detailed Mode

Scheduled Wakeup and Sleep Settings

By clicking the Scheduled Wakeup and Sleep button, you access the window shown in Figure 4-27.



Settings for: Power Adapter

☑ Wake up the computer
Weekdays
at 8:30 AM

☑ Put the computer to sleep
Weekdays
at 5:30 PM

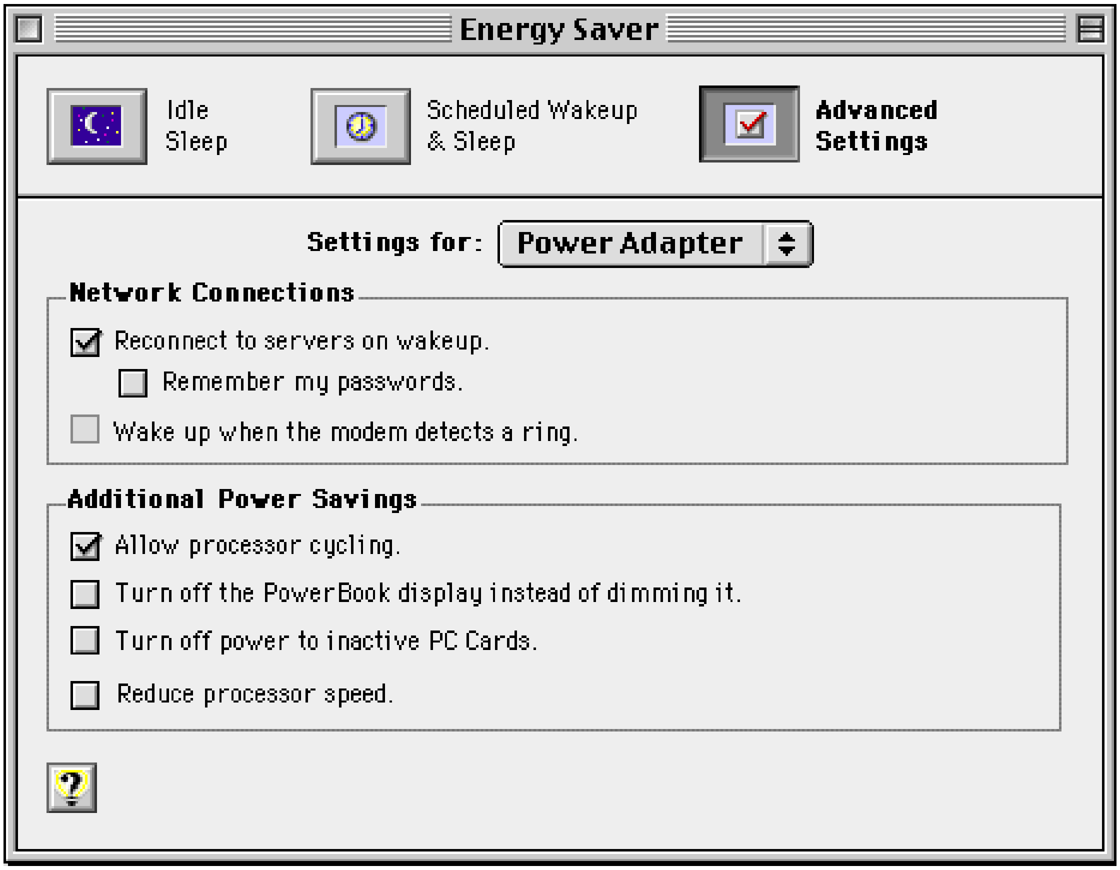
Figure 4-27: Energy Saver Wakeup/Sleep Window

This window allows you to set the computer to wake up or sleep at a predetermined time. The “Settings for” pop-up menu allows you to choose two separate sets of sleep / wake settings — one for when the PowerBook computer is using its battery and one for when it is using the power adapter.

Troubleshooting Note — If a customer complains that the computer is not waking and sleeping as expected, ask them to check both the battery and power adapter settings on this screen.

Advanced Settings

By clicking the Advanced Settings button, you access options for network connections and additional power savings (Figure 4-28).



Settings for: Power Adapter

Network Connections

☑ Reconnect to servers on wakeup.

☐ Remember my passwords.

☐ Wake up when the modem detects a ring.

Additional Power Savings

☑ Allow processor cycling.

☐ Turn off the PowerBook display instead of dimming it.

☐ Turn off power to inactive PC Cards.

☐ Reduce processor speed.

Figure 4-28: Energy Saver Advanced Settings Window

- Network Connections – The “Reconnect to servers on wakeup” feature tells the computer to re-establish network connections with mounted servers when the computer comes out of sleep mode.

  The “Wake up when the modem detects a ring” feature cannot be selected, because Wake on Ring is not supported in the PowerBook G3 Series computers.
- Additional Power Savings – The section offers the following options:
  - Allow processor cycling – This option works in the same manner as on previous PowerBook computers — it slows down the processor when the processor is not in use or when the PowerBook computer detects that there has been no mouse or keyboard activity for a specified period of time.
  - Turn off the PowerBook display instead of dimming it – Turning off the display allows for greater power savings, which can be important when the PowerBook computer is operating on battery power.

- Turn off power to inactive PC cards – Many PC cards will draw power even when they are not being used. This option cuts off power to PC cards that are installed but inactive.
- Reduce processor speed – When this option is selected, the processor slows down from its original speed. The “reduced processor speed” function will reduce the processor speed to 25 percent of its full speed. For example, a 250 MHz machine would appear to the user to run at 62.5 MHz. The PowerBook computer does not need to be restarted for this feature to take effect; the setting will become active when the energy saver control panel is closed.

Troubleshooting Note — If a PowerBook computer is running more slowly than expected, examine the “Reduce processor speed” option. If this option is selected, explain to the customer what the feature does. If the battery savings is not needed, deselect the option. Make sure to check both the battery and power adapter versions of the settings.

Energy Saver Control Strip Module

The Energy Saver control strip module on the PowerBook G3 Series (Figure 4-29) combines the functions of the Sleep Now and Power Setting control strip modules used in previous PowerBook models.

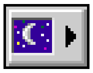


Figure 4-29: Energy Saver Control Strip Module

This module allows users to access the Energy Saver control panel, to choose Better Conservation or Better Performance settings from the control strip, or to put the computer to sleep immediately.

Responding to Low-Power Messages

When the battery charge drops to about 15 percent, the computer displays a series of low-power messages. The work time remaining after you see the first message varies depending on how you are using the computer. It’s a good idea to act promptly.

When you see a low-power message, you should either plug in the power adapter, or save your work and put the computer to sleep.

The first low-power message indicates that it’s time to recharge the battery. Right after this message appears, the screen brightness dims to save power. If you continue to work without plugging in the power adapter, the computer displays a second low-power message.

The second message is followed almost immediately by a third and final message indicating that the computer is about to put itself to sleep. When time is up, the computer goes to sleep automatically to protect the contents of RAM. At that point, you must plug in a power adapter to continue working.

If you continue working until the computer goes to sleep automatically, you may not be able to wake it again until you recharge the depleted battery in the computer for 15 minutes.

If you can’t plug in the power adapter, the contents of RAM are retained in sleep for at least two days. If you leave the battery in the computer and recharge it within two days, you should be able to wake the computer and resume work where you left off.

Caution — Recharge a depleted battery as soon as possible. Leaving a depleted battery in the computer for longer than two weeks (especially in a hot location, such as the trunk of a car) may damage the battery so that it can’t be recharged. If this happens, you must replace the battery.

Recharging the Battery

There are two ways to recharge a battery:

- Plug in the power adapter to recharge the battery while it is in the computer.
- Remove the battery and recharge it in a battery recharger.

Some batteries have movable tabs or buttons on them. These tabs and buttons have nothing to do with recharging, and are changed by the user to indicate that a battery is charged or needs to be charged.

Recharging with the Power Adapter

Plug in the power adapter as shown in Figure 4-30. (You do not need to shut down the computer before plugging in the adapter, but always connect the adapter to AC power before you attach the adapter to the computer.)

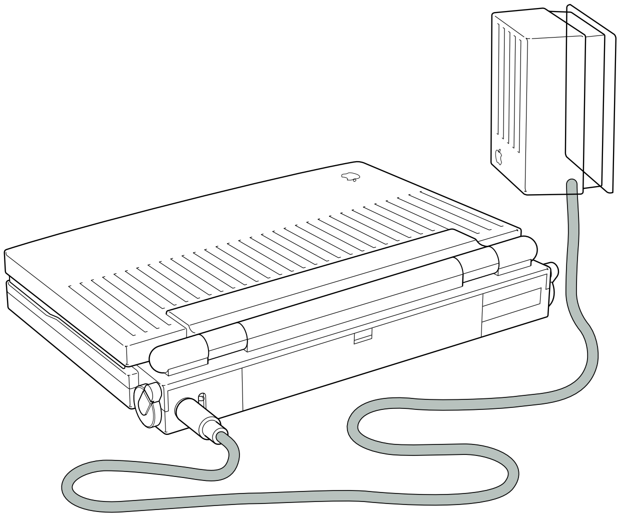


Figure 4-30: Connecting the Power Adapter

Caution — Use only the power adapter that came with your PowerBook computer. Adapters for other electronic devices (including other portable computers) may look similar, but they can damage your computer.

You can continue to use the computer while the battery is recharging, but the battery will take longer to recharge if you do. Battery recharging time while the computer is in use depends on how often you use the hard drive, how bright the screen is, whether you are using an external monitor, how completely the battery is depleted, and other factors.

If you are using several power-consuming features (such as an external monitor and a program that requires frequent hard drive access) and you are not using the features designed to conserve power (such as processor cycling), the battery may not recharge until you put the computer to sleep or shut it down.

Note — While the computer is shut down and the power adapter is plugged in, you can remove a charged battery from the computer and replace it with a battery you want to charge. If you do this, disconnect the power adapter from the computer and then reconnect the power adapter after you insert the second battery; otherwise, the second battery will not recharge.

Recharging with a Recharger

Caution — The instructions in this section apply only to Apple battery rechargers, which are not available for all PowerBook models. Adapters for other electronic devices (including other portable computers) may look similar, but they can damage your batteries.

A battery recharger and additional batteries are options with some PowerBook models. If a user purchases a recharger and an extra battery, one battery can be charging while the other is in use, so that there is always a fully charged battery on hand.

Apple rechargers accommodate two batteries. The battery slots work independently, so you can put batteries in or take them out at different times.

The recharger must be plugged into an electrical outlet to charge a battery. You can plug it in using the power adapter that came with the computer, or use an additional (identical) power adapter.

Caution — Use only the power adapter that came with the recharger. Using another adapter may damage the adapter, the recharger, or both.

To recharge a battery with a recharger, follow these steps:

1. Place the recharger on a level surface.
2. Connect the power adapter or the power cable, depending on recharger model, to the battery recharger and to an electrical outlet.
3. Place the battery in the recharger as shown in Figure 4-31.

Note — You must use only the power adapter, battery recharger, and batteries that are designed to work with the PowerBook computer you are servicing. Refer to the appropriate hardware service manual on Service Source for power specifications.

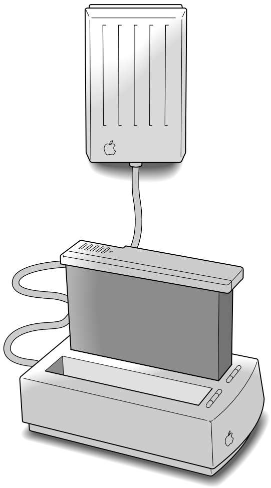


Figure 4-31: Using the Battery Recharger

When you place a battery in a recharger, charging begins immediately. You can remove a battery from the recharger at any time.

Note — To preserve a battery's charge, don't leave the battery in the recharger if the power adapter is not plugged into an electrical outlet.

The lights on the recharger indicate the following:

- Yellow – The battery is charging.
- Green – The battery is charged to at least 80 percent of its capacity and can be used.
- Red – The battery recharger is unable to charge this type of battery. Some PowerBook computers require that a battery INIT file be installed in the computer using the battery. Once the

battery INIT is installed, and the battery has been used in the computer with the battery INIT, the battery should be able to be recharged by the battery recharger.

Guidelines for Recharging Batteries

Different PowerBook models use different kinds of batteries; it's important to know which type of battery is required in order to recharge it properly.

Apple Computer has used four different types of batteries for PowerBook computers:

- Sealed Lead Acid (SLA) (PowerBook 100 only)
- Nickel Cadmium (NiCad) (PowerBook 140-180c)
- Nickel Metal Hydride (NiMH) (PowerBook 190, 200 Series, 500 Series, 1400, 2300, 5300)
- Lithium Ion (Li+ or LiIon) (PowerBook 2400, 3400, G3, G3 Series)

Each type of battery requires a different recharging technique to ensure maximum battery life. Refer to the Apple Spec Database on Service Source for battery requirements for the PowerBook computer you are servicing.

Sealed Lead Acid

Recharge sealed lead acid batteries whenever they become depleted and never fully discharge the battery. Lead acid batteries should always be kept fully charged.

If a lead acid battery becomes fully discharged, it may experience sulfation. Sulfation occurs when the lead electrodes inside the battery convert to lead sulfate. This destroys the battery, making it unable to hold a charge.

Nickel Cadmium (NiCad)

Recharge nickel cadmium (NiCad) batteries when they become depleted. Apple recommends fully discharging and recharging the battery approximately every 90 days.

Nickel cadmium batteries are subject to an issue known as “memory effect.” If a NiCad battery is only partially discharged, then recharged many times, it will begin to “remember” the level it was discharged to and won't fully recharge.

Here's an example: Let's assume your battery has a normal capacity of 2.5 hours and you use your computer for an hour a day, then recharge the battery overnight. After a period of time, approximately between 30-90 days, you'll discover that your battery now has a capacity of a little over an hour, instead of 2.5 hours.

The only way to recover the battery's full capacity is to fully discharge it, then fully recharge it.

Nickel Metal Hydride (NiMH)

Like nickel cadmium batteries, nickel metal hydride (NiMH) batteries are also subject to the memory effect. Recharge nickel metal hydride batteries when they become depleted. Fully discharge and recharge the NiMH battery approximately every 30 days.

Lithium Ion (LiIon or Li+)

Lithium Ion (LiIon, or Li+) batteries are not subject to the memory effect and, therefore, have no need for periodic reconditioning. However, if the battery is not used for 2-3 months, the battery should be recharged.

LiIon batteries have battery level indicator lights (Figure 4-32) that tell whether the battery is fully charged, three-fourths charged, one-half charged, one-fourth charged, or depleted. If the battery lights blink, there is a problem with the battery. To check the battery status, press and hold the button to the left of the lights until they light up.

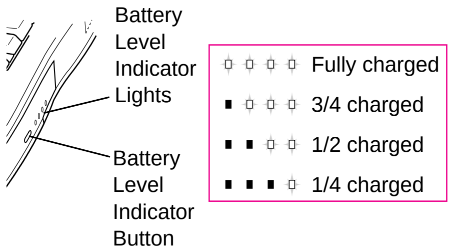


Figure 4-32: LiIon Battery Lights

While the battery is being charged, the lights indicating the charge level will be on. When the battery is fully charged, all the lights will turn off.

Note — You must remove the battery from the computer to view these indicator lights.

Restoring Battery Life

In general, if PowerBook users complain that they do not seem to be getting the battery life they once did, you should reset the PowerBook power manager and check that proper power conservation settings have been made in the PowerBook or Energy Saver control panel.

In addition, for models with NiCad or NiMH batteries, you should recondition the battery by completely discharging it. There are two ways to recondition batteries:

- Use the computer normally, and ignore the low-power messages that appear on the screen. (Be sure, however, to save your work frequently.) When the computer goes to sleep automatically, recharge the battery completely before using that battery again.
- Use Battery Reconditioning software. For the PowerBook 270c, 280, 280c, 2300, 190, and 5300, Battery Reconditioning software is included on a Battery Tools disk or in the Utilities Folder on the Hard Drive. The Battery Reconditioning software automatically controls discharging and recharging of the battery, and it tells the user whether reconditioning was recently performed.

Verifying the Battery and Recharger

When you are servicing a PowerBook computer, you may need to verify the operation of a battery or the battery recharger. You can find the verification procedures on Service Source. Before continuing with this module, please complete the following exercise:

1. Open one of the PowerBook hardware service manuals on Service Source.
2. Open the Additional Procedures chapter, select Battery Verification, and carefully review the section.
3. Select AC Adapter Verification from the Additional Procedures chapter and carefully review the section. (If AC Adapter Verification is not available for the PowerBook model you selected, review the procedures for a different model.)

Power Management Tips and Guidelines

Keep the following tips and guidelines in mind as you use your PowerBook computer:

- Keep screen dimming turned on. This setting dims the screen whenever the computer is idle for a few minutes.
- Keep virtual memory turned off in the Memory control panel.

Note — Many PowerBook computers ship with virtual memory turned on. For information on using virtual memory, see the User's Guide or the "Memory" topic of Macintosh Guide, available in the Guide (Help) window.

- If your computer has at least 6 MB of memory, you can use a RAM disk as your startup disk, which will minimize hard drive use.
- Quit any program that uses a modem unless you're using the program for telecommunications. As long as the program is open, your modem is consuming power (not applicable when you have an Express Modem).
- Apple recommends that you use and/or store PowerBook computers with the main battery in place to prevent the backup batteries from becoming drained and dirt from entering the battery compartment.
- Leave the Battery desk accessory or Control Strip open on the desktop so you can track the battery charge while you work.
- When using the Battery, set the Power Management features to the "Better Conservation" setting.
- Set the backlight dimming time lower on the PowerBook Display control panel (System 7.1).
- Set processor cycling to the "Allow Cycling" setting unless you are using a program that seems to be performing very slowly.
- Set processor speed for the "Reduced speed" setting (more battery savings) in the PowerBook or Energy Saver control panel.
- To maintain battery charge, use the power adapter whenever possible. Verify that the power adapter is plugged into an operating electrical outlet.
- Connect only low-power ADB devices to the ADB port.
- Turn off AppleTalk in the Chooser (Mac OS versions prior to 8.1). When AppleTalk is activated, and the computer is connected to the power adapter, the computer will not automatically initiate sleep mode.
- Avoid using disk-intensive applications (HyperCard, database programs, QuickTime) while the computer is operating off the battery.

- Keep files and/or programs in memory if you have enough RAM and software that supports this feature.
- Simultaneously open the files you want to work on so the disk spins up a single time.
- Dispose of spent batteries in accordance with the guidelines on Service Source and in accordance with local ordinances.

Note — When you are ready, complete the Power Management Exercise beginning on the next page.

Exercise 1: Power Management

Respond to the following items. Try to respond from memory. If you need assistance, review the previous section of this module.

1. Describe sleep mode, how to manually place the computer into sleep mode, and how to manually wake it up.

2. With system software versions below 7.1.1, how can you determine the battery’s charge level?

3. With system software versions below 7.1.1, what would you use to increase or decrease battery conservation?

4. How does an increase in battery conservation affect power usage?

5. With system software versions below 7.1.1, how would you access the “Don’t sleep when plugged in” and processor speed options?

6. Briefly contrast the function of the processor speed option with the processor cycling option, and tell why these options are offered.

7. With system software versions below 7.1.1, how would you access the processor cycling option?

____
____
____

8. List two situations when a PowerBook computer will not automatically be placed in sleep mode.

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9. When using system software version 7.1.1 and later, what would you use to increase or decrease battery conservation?

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10. When using system software version 7.1.1 and later, how would you access the controls that allow you to manually set the minutes of inactivity before the system, hard drive, and screen are placed into sleep mode?

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____
____

11. When using system software version 7.1.1 and later, how would you access the processor cycling option?

____
____
____

12. What should you do when you receive the first low-power

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____
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13. You must shut down the PowerBook computer before connecting the power adapter.

    True

    False

14. With the power adapter connected to the PowerBook computer, the battery will recharge while you are using the computer.

True

False

15. What does the yellow light on the battery recharger indicate when lighted?

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16. It’s a good idea to leave the Battery desk accessory or Control Strip open on the desktop so you can track the battery charge while you work.

True

False

17. List the steps for setting up and using the battery recharger.

____

____

____

18. Match the description(s) on the right that apply to each battery type on the left. More than one description may apply to each battery type, and a description may also apply to more than one battery type.

Battery Type	**Description**
Sealed Lead Acid (SLA)	A. Fully discharge and recharge every 90 days
____________________	B. Fully discharge and recharge every 30 days
Nickel Cadmium (N. Cad)	C. Never fully discharge
____________________	D. Recharge when depleted
Nickel Metal Hydride (NiMH)	E. Always keep fully charged
____________________	F. Subject to “memory effect”

19. If you remove the main battery from a PowerBook computer connected to a power adapter and replace it with another battery, the power adapter must be disconnected and then reconnected to recharge the newly installed battery.

True

False

20. Where on Service Source can you find procedures for verifying operation of the battery and battery recharger?

____

____

____

Note — When you are finished, compare your answers with those on the following page.

Exercise 1: Answers

Compare your answers to Exercise 1 with those given below.

1. Describe sleep mode, how to manually place the computer into sleep mode, and how to manually wake it up.

   In sleep mode, the computer is fully functional but in a resting state in which the computer appears to be shut down but is instead operating at a reduced power level which conserves power. Use the Sleep command in the Special menu to place the computer in sleep mode, and press any key except Caps Lock to wake up the computer.

2. With system software versions below 7.1.1, how can you determine the battery's charge level?

   Check the battery charge level by opening the Battery desk accessory.

3. With system software versions below 7.1.1, what would you use to increase or decrease battery conservation?

   Use the PowerBook control panel (labeled Portable in some versions of software) to change battery conservation levels.

4. How does an increase in battery conservation affect power usage?

   Increasing battery conservation decreases the amount of time before the computer is placed into sleep mode during periods of inactivity.

5. With system software versions below 7.1.1, how would you access the "Don't sleep when plugged in" and processor speed options?

   Click on the Options button in the PowerBook control panel.

6. Briefly contrast the function of the processor speed feature with the processor cycling feature, and tell why these features are offered.

   The processor speed feature reduces the speed of the processor until it is manually reset to normal speed. The processor cycling feature reduces the speed of the processor only when it is not being used. Both features reduce power usage.

7. With system software versions below 7.1.1, how would you access the processor cycling option?

   Hold down the Option key on your keyboard and click the Options button on the PowerBook control panel (If you are running System 7.1, you don’t need to hold down the Option key).

8. List two situations when a PowerBook computer will not automatically be placed in sleep mode.

   Automatic sleep does not take effect under any of the following circumstances (you need only list two):

   - AppleTalk is turned on in the Chooser and the power adapter is plugged in
   - The computer is connected to a shared disk on the network
   - The computer’s printer or modem port is in use.
   - Sleep is set to “Never” in the control panel.

9. When using system software version 7.1.1 and later, what would you use to increase or decrease battery conservation?

   Use the PowerBook control panel to increase or decrease battery conservation.

10. When using system software version 7.1.1 and later, how would you access the controls that allow you to manually set the minutes of inactivity before the system, hard drive, and screen are placed into sleep mode?

    Click on the Custom button in the PowerBook control panel.

11. When using system software version 7.1.1 and later, how would you access the processor cycling option?

    Hold down the Option key while you click on the Custom button in the PowerBook control panel.

12. What should you do when you receive the first low-power warning message?

    Plug in the power adapter, or save your work and put the computer to sleep.

13. You must shut down the PowerBook computer before connecting the power adapter.

    False

14. With the power adapter connected to the PowerBook computer, the battery will recharge while you are using the computer.

    True

15. What does the yellow light on the battery recharger indicate when lighted?

    The yellow light indicates that the battery is charging.

16. It’s a good idea to leave the Battery desk accessory or Control Strip open on the desktop so you can track the battery charge while you work.

    True

17. List the steps for setting up and using the battery recharger.

    a. Connect the power adapter, or power cable depending on the recharger model, to the battery recharger and to an electrical outlet. Ensure that the yellow LED lights.

    b. Place the battery to be charged in the battery recharger.

    c. Install the recharged battery in the computer when the green LED lights on the battery recharger.

18. Match the description(s) on the right that apply to each battery type on the left. More than one description may apply to each battery type, and a description may also apply to more than one battery type.

Battery Type	**Description**
Sealed Lead Acid (SLA)	A. Fully discharge and recharge every 90 days
C, E	B. Fully discharge and recharge every 30 days
Nickel Cadmium (N. Cad)	C. Never fully discharge
A, D, F	D. Recharge when depleted
Nickel Metal Hydride (NiMH)	E. Always keep fully charged
B, D, F	F. Subject to “memory effect”

19. If you remove the main battery from a PowerBook computer connected to a power adapter and replace it with another battery, the power adapter must be disconnected and then reconnected to recharge the newly installed battery.

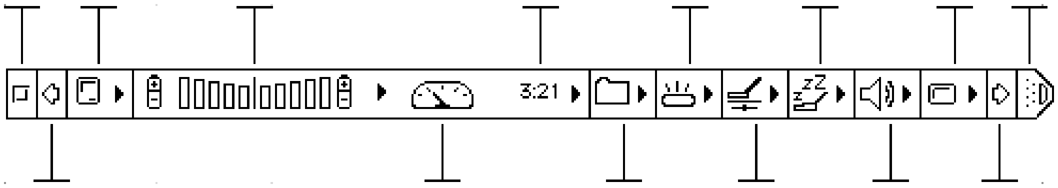
    True

20. Where on Service Source can you find procedures for verifying operation of the battery and battery recharger?

    a. Select the appropriate PowerBook hardware service manual on Service Source.
    b. Open the Additional Procedures chapter.
    c. Review the Battery Verification and AC Adapter Verification sections.

Exercise 2: Control Strip

Match the name and function of each icon with its location on the Control Strip. Write the appropriate number and letter next to the line provided for the icon on the illustration.

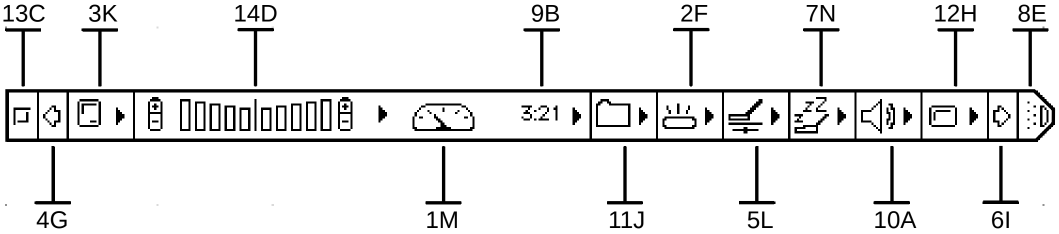


	Name		Function
1.	Battery consumption rate	A.	Increases/decreases volume
2.	Hard disk module	B.	Indicates amount of time left on batteries
3.	AppleTalk switch module	C.	Enables you to close Control Strip
4.	Left scroll arrow	D.	Shows battery level
5.	Power setting module	E.	Resizes Control Strip
6.	Right scroll arrow	F.	Turns off or spins down hard drive
7.	Sleep now module	G.	Scrolls to the left
8.	Tab	H.	Displays video on a second monitor
9.	Estimated work time remaining	I.	Scrolls to the right
10.	Sound volume module	J.	Turns file sharing on
11.	File sharing	K.	Makes AppleTalk active or inactive
12.	Video mirroring	L.	Opens the control panel
13.	Close box	M.	Indicates rate of battery usage
14.	Battery icons and charge scales	N.	Puts system to sleep

Note — When you are finished, compare your answers with those on the following page.

Exercise 2: Answers

Compare your answers to Exercise 2 with those given below.



	Name		**Function**
1.	Battery consumption rate	A.	Increases/decreases volume
2.	Hard disk module	B.	Indicates amount of time left on batteries
3.	AppleTalk switch module	C.	Enables you to close Control Strip
4.	Left scroll arrow	D.	Shows battery level
5.	Power setting module	E.	Resizes Control Strip
6.	Right scroll arrow	F.	Turns off or spins down hard drive
7.	Sleep now module	G.	Scrolls to the left
8.	Tab	H.	Displays video on a second monitor
9.	Estimated work time remaining	I.	Scrolls to the right
10.	Sound volume module	J.	Turns file sharing on
11.	File sharing	K.	Makes AppleTalk active or inactive
12.	Video mirroring	L.	Opens the control panel
13.	Close box	M.	Indicates rate of battery usage
14.	Battery icons and charge scale	N.	Puts system to sleep

Note — If you missed more than two items in Exercises 1 and 2, carefully review this module and the exercises before you continue with the module test.

Test: Power Management Skills

Be sure you have successfully completed the exercises and test in Module 1, which contain several power-management related items. Then proceed with the following questions.

Try to answer these questions from memory. If you cannot answer them from memory, refer to this module or to the appropriate User's Guide or hardware service manual on Service Source.

1. The power management features introduced with the PowerBook G3 Series computers are different than those of the PowerBook G3.
   a. True.
   b. False.
2. A PowerBook computer must always be shut down and restarted to regain full functionality after being in sleep mode.
   a. True.
   b. False.
3. You can find the procedures for battery and power adapter verification for each PowerBook model in:
   a. The "Additional Procedures" section of that model's hardware service manual on *Service Source* CD.
   b. The Technical Information Library (TIL).
   c. The user manual for that PowerBook model on *Service Source* CD.
   d. The Safety section on *Service Source* CD.
4. A 250-MHz PowerBook G3 will appear to run more slowly than a 66-MHz PowerBook 190 when:
   a. "Reduce processor speed" is selected.
   b. The memory chips are seated improperly.
   c. The power management software is corrupt.
   d. The PowerBook G3 is in sleep mode.

5. With which version of the operating system can you begin to use the Control Strip?

   a. System 7.5.

   b. Mac OS 8.1.

   c. Mac OS 8.

   d. System 7.1.1.

6. To avoid possible damage to your computer, you should use only Apple battery rechargers, rather than rechargers for other electronic devices.

   a. True.

   b. False.

7. The PowerBook control panel is replaced by the Energy Saver control panel with the advent of which computer?

   a. The PowerBook G3 Series computers.

   b. None, the Energy Saver control panel replaces the Monitors control panel.

   c. The PowerBook G3 computer.

   d. The first PPC PowerBook model (PowerBook 5300).

   e. The first LiIon-powered PowerBook computer (PowerBook 190).

8. The Battery desk accessory is used to eject the battery.

   a. True.

   b. False.

9. You use the PowerBook control panel to adjust the following settings: (Check all that apply.)

   a. Conservation / performance level.

   b. Processor speed.

   c. Processor cycling.

   d. Battery recharge rate.

   e. Control Strip-accessible options.

10. Which of the following items found on the Control Strip can help with power management? (Check all that apply.)

    a. AppleTalk Switch module.

    b. Control Strip control panel module.

    c. File Sharing module.

    d. Sound Volume module.

    e. Hard Disk module.

11. The Control Strip will not appear under the following circumstances: (Check all that apply.)

    a. The user is running System 7.1.3.

    b. Hide Control Strip is selected in the Control Strip control panel.

    c. The user has pressed the hot key to hide the Control Strip.

    d. The PowerBook display is too small (minimum 14” required).

    e. The Control Strip is hidden behind an application window.

12. Some of the items added to the PowerBook control panel with System 7.1.1 include: (Check all that apply.)

    a. The Easy/Custom switch.

    b. Separate control for when the hard disk spins down.

    c. The option to reduce processor speed.

    d. The option to allow processor cycling.

    e. Different power conservation settings for when the power adapter is connected.

    f. A default button to restore the PowerBook computer to factory settings.

13. If you want to set a PowerBook computer to go to sleep and wake up automatically at preset times, use:

    a. The Battery desk accessory.

    b. The Energy Saver control panel.

    c. The Sleep Now module on the Control Strip.

    d. The PowerBook control panel.

14. You set separate timing for the hard disk spinning down and the display dimming using the following: (Check all that apply.)
    - a. The Energy Saver control panel in Mac OS 8.
    - b. The PowerBook control panel in System 7.
    - c. The PowerBook control panel in System 7.5.
    - d. The Battery desk accessory in System 7.
    - e. The Hard Disk and Video Mirroring modules of the Control Strip.
15. You can specify separate battery and power adapter power management settings using the following:
    - a. The Energy Saver control panel.
    - b. The Battery desk accessory.
    - c. The Power Adapter control panel.
    - d. The Control Strip control panel.
16. You can realize additional power savings when you enable the following settings in the Energy Saver control panel: (Check all that apply.)
    - a. Reduce processor speed.
    - b. Turn off AppleTalk.
    - c. Turn off power to inactive PC cards.
    - d. Turn off PowerBook display instead of dimming it.
    - e. Turn off Wake on Ring feature.
17. You can set the PowerBook control panel to automatically reconnect to networked volumes on waking from the sleep mode.
    - a. True.
    - b. False.

18. Use the Energy Saver Control Strip module to do the following: (Check all that apply.)

    a. Shut down the computer.

    b. Choose the Better Conservation setting.

    c. Put the PowerBook computer into sleep mode.

    d. Open the Battery desk accessory.

    e. Open the PowerBook control panel.

19. If, when testing a PowerBook computer, you get a low-power warning and the computer almost immediately goes into sleep mode, you should:

    a. Let the machine sit for three days to flush corrupted RAM.

    b. Replace the faulty battery with a fresh one.

    c. Connect the power adapter.

    d. Wake the computer, save changes, and shut down.

20. How many low-power warning messages do you get before the PowerBook computer automatically goes into sleep mode?

    a. Depends on how depleted the battery is.

    b. Five.

    c. Three.

    d. Depends on how the computer is being used.

21. What is the best thing to do as soon as you get the first battery low-power warning?

    a. Shut down the computer, saving changes.

    b. Remove the battery so it doesn’t leak.

    c. Connect the power adapter.

    d. Continue working until you get the second warning.

22. If you put a PowerBook computer running on battery into sleep mode and later cannot wake it, the problem is most likely:

    a. The Return key on the keyboard is not making contact.

    b. The PowerBook computer is not in the proper cycle to wake.

    c. The battery is too depleted to wake.

    d. The power management software is corrupt.

23. If a PowerBook display dims regardless of the display dimming setting in the PowerBook control panel, then the following is most likely the case:

    a. The power management software is corrupt.

    b. The display diagnostics indicate a failing display.

    c. The battery is low on power.

    d. There is processor-intensive activity.

24. It is recommended that you not leave a depleted battery in a computer in a car trunk for longer than two weeks because:

    a. The car may be ticketed.

    b. The computer may be damaged.

    c. The battery could explode.

    d. The computer may be stolen.

    e. The battery may be irreparably damaged.

25. The best thing to do with a fully depleted battery is to:

    a. Discard it; the “memory effect” makes it useless.

    b. Put it in the refrigerator to extend its life.

    c. Recharge it using a computer or recharger.

    d. Replace it with a more modern type of battery.

26. Which of the following batteries work in appropriate PowerBook computers? (Check all that apply.)

    a. Sealed Lead Acid.

    b. Alkaline.

    c. Nickel Metal Hydride.

    d. Lithium Ion.

    e. Nickel Cadmium.

    f. Solar.

27. Any power adapter will work for recharging a PowerBook computer battery, as long as the voltage is correct.

    a. True.

    b. False.

28. The following kinds of batteries benefit from periodically fully discharging them: (Check all that apply.)

    a. Sealed Lead Acid.

    b. Alkaline.

    c. Nickel Metal Hydride.

    d. Lithium Ion.

    e. Nickel Cadmium.

    f. Solar.

29. The memory effect, in relation to batteries, refers to the fact that certain types of batteries, if recharged many times without being fully discharged, will “remember” the partially charged level and not charge beyond that.

    a. True.

    b. False.

30. The Battery desk accessory is available as part of all Macintosh operating systems through Mac OS 8.

    a. True.

    b. False.

31. The best initial place to find the guidelines for properly disposing of PowerBook computer batteries is:

    a. This module of PowerBook Technology and Troubleshooting.

    b. Hardware service manuals on *Service Source* CD.

    c. The Technical Information Library (TIL).

    d. Your local recycling center.

32. Although showing the Control Strip makes access to power management tools easier, it drains the battery faster.

    a. True.

    b. False.

33. Sleep is a low-power mode. Waking up from sleep is faster than restarting.

    a. True.

    b. False.

Test: Answers

1. The power management features introduced with the PowerBook G3 Series computers are different than those of the PowerBook G3.

   a. True. (The PowerBook G3 is not part of the PowerBook G3 Series computers.)

2. A PowerBook computer must always be shut down and restarted to regain full functionality after being in sleep mode.

   b. False.

3. You can find the procedures for battery and power adapter verification for each PowerBook model in:

   a. The “Additional Procedures” section of that model’s hardware service manual on *Service Source* CD.

4. A 250-MHz PowerBook G3 will appear to run more slowly than a 66-MHz PowerBook 190 when:

   a. “Reduce processor speed” is selected.

5. With which version of the operating system can you begin to use the Control Strip?

   d. System 7.1.1.

6. To avoid possible damage to your computer, you should use only Apple battery rechargers, rather than rechargers for other electronic devices.

   a. True.

7. The PowerBook control panel is replaced by the Energy Saver control panel with the advent of which computer?

   a. The PowerBook G3 Series computers.

8. The Battery desk accessory is used to eject the battery.

   b. False.

9. You use the PowerBook control panel to adjust the following settings: (Check all that apply.)

   a. Conservation / performance level.

   b. Processor speed.

   c. Processor cycling.

10. Which of the following items found on the Control Strip can help with power management? (Check all that apply.)

    a. AppleTalk Switch module.

    c. File Sharing module.

    e. Hard Disk module.

11. The Control Strip will not appear under the following circumstances: (Check all that apply.)

    b. Hide Control Strip is selected in the Control Strip control panel.

    c. The user has pressed the hot key to hide the Control Strip.The Control Strip is hidden behind an application window.

12. Some of the items added to the PowerBook control panel with System 7.1.1 include: (Check all that apply.)

    b. Separate control for when the hard disk spins down.

    e. Different power conservation settings for when the power adapter is connected.

13. If you want to set a PowerBook computer to go to sleep and wake up automatically at preset times, use:

    b. The Energy Saver control panel.

14. You set separate timing for the hard disk spinning down and the display dimming using the following: (Check all that apply.)

    a. The Energy Saver control panel in Mac OS 8.

    c. The PowerBook control panel in System 7.5.

15. You can specify separate battery and power adapter power management settings using the following:

    a. The Energy Saver control panel.

16. You can realize additional power savings when you enable the following settings in the Energy Saver control panel: (Check all that apply.)

    a. Reduce processor speed.

    c. Turn off power to inactive PC cards.

    d. Turn off PowerBook display instead of dimming it.

17. You can set the PowerBook control panel to automatically reconnect to networked volumes on waking from the sleep mode.

    a. True.

18. Use the Energy Saver Control Strip module to do the following: (Check all that apply.)

    b. Choose the Better Conservation setting.

    c. Put the PowerBook computer into sleep mode.

19. If, when testing a PowerBook computer, you get a low-power warning and the computer almost immediately goes into sleep mode, you should:

    c. Connect the power adapter.

20. How many low-power warning messages do you get before the PowerBook computer automatically goes into sleep mode?

    c. Three.

21. What is the best thing to do as soon as you get the first battery low-power warning?

    c. Connect the power adapter.

22. If you put a PowerBook computer running on battery into sleep mode and later cannot wake it, the problem is most likely:

    c. The battery is too depleted to wake.

23. If a PowerBook display dims regardless of the display dimming setting in the PowerBook control panel, then the following is most likely the case:

    c. The battery is low on power.

24. It is recommended that you not leave a depleted battery in a computer in a car trunk for longer than two weeks because:

    e. The battery may be irreparably damaged.

25. The best thing to do with a fully depleted battery is to:

    c. Recharge it using a computer or recharger.

26. Which of the following batteries work in appropriate PowerBook computers? (Check all that apply.)

    a. Sealed Lead Acid.

    c. Nickel Metal Hydride.

    d.Lithium Ion.

    e. Nickel Cadmium.

27. Any power adapter will work for recharging a PowerBook computer battery, as long as the voltage is correct.

    b. False.

28. The following kinds of batteries benefit from periodically fully discharging them: (Check all that apply.)

    c. Nickel Metal Hydride.

    e. Nickel Cadmium.

29. The “memory effect”, in relation to batteries, refers to the fact that certain types of batteries, if recharged many times without being fully discharged, will “remember” the partially charged level and not charge beyond that.

    a. True.

30. The Battery desk accessory is available as part of all Macintosh operating systems through Mac OS 8.

    b. False.

31. The best initial place to find the guidelines for properly disposing of PowerBook computer batteries is:

    b. hardware service manuals on *Service Source* CD.

32. Although showing the Control Strip makes access to power management tools easier, it drains the battery faster.

    b. False.

33. Sleep is a low-power mode. Waking up from sleep is faster than restarting.

    a. True.

Troubleshooting PowerBook Computers

5

This module gives an overview of procedures and resources used to troubleshoot PowerBook computers.

What You Will Learn

When you finish this module, you will be able to identify the troubleshooting process and resources to use when you service PowerBook computers.

The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module.

Required Materials and Equipment

This module requires the following materials and equipment:

- PowerBook computer (to use MacTest Pro software)
- MacTest Pro diagnostic software (PowerPC version or 680x0 version, whichever applies to the PowerBook computer you are using)
- Service Source (April 1998 or later)
- Macintosh computer capable of running *Service Source* CD (for hardware platform requirements, see the *Service Source* CD booklet)
- Access to the Internet (optional)

Time to Complete This Module

This module should take approximately 90 minutes to complete.

Skills Checklist

If you think you already possess the following skills, go directly to the module exercises. If you pass the exercises, congratulations! Go on to the next module. If you do not pass the exercises, complete this module before proceeding.

______ • List the seven major steps in the troubleshooting process.

______ • List at least six Apple troubleshooting and repair resources.

• Given a description of a PowerBook problem,

______ ▪ Identify the reference source most likely to give helpful information about the problem.

______ ▪ Find the information requested in Service Source, the Apple Parts Database, or the Tech Info Library.

______ • List four tips you need to be aware of when you run MacTest Pro diagnostic tests on a PowerBook computer.

______ • Choose the appropriate MacTest Pro test modules for troubleshooting specified PowerBook problem situations.

Troubleshooting Process Review

The process used to troubleshoot PowerBook computers is the same troubleshooting process you learned in the *Macintosh Service & Tools Course*. The major steps in this process are as follows:

1. Gather information from the customer.
2. Verify the problem (duplicate the symptoms reported by the user).

Note — *Always* verify (duplicate) the customer's problem before you attempt a repair. Once you make changes to the hardware or software, you cannot distinguish the original problem from possible problems introduced by your changes. In fact, you will never be able to tell whether the original problem was possibly due to user error. So never attempt a repair—or even a quick fix—before you verify the problem.

---

3. Try quick fixes.
4. Run appropriate diagnostic tests.
5. Use systematic fault isolation procedures, referring to Service Source or Apple Service Guides for product-specific guidance.
6. Use additional resources (such as the Tech Info Library) to research the problem.
7. Escalate if necessary to a technical assistance group.

At any point in this process, you may find the solution to the reported problem. When that happens, you need to do the following:

1. Repair or replace the faulty item.
2. Verify the repair by testing the product thoroughly.
3. Inform the user what you have done.
4. Complete whatever administrative tasks your organization requires.

Troubleshooting Resources

The following resources can help you troubleshoot PowerBook computer problems:

- *Service Source* CD (SSCD) (described later in this module) – The main reference source for Authorized Apple Service Providers.

  Service Source 2.5 includes:

  - Service Source Hardware Service Manuals
  - Apple Memory Guide
  - Service Parts Database
  - Apple Spec Database

- Service Source Online (http://service.info.apple.com/) – Apple's Internet site for service information. Only subscribers to Service Source have access to this password-protected site. In each mailing of the *Service Source* CD, subscribers receive a new account name and password in the Online News tab of Service Source Startup.

  Service Source Online contains information and bulletins (including entire service manuals) that have been published since the last *Service Source* CD was produced. Service Source Online also includes online versions of many features of *Service Source* CD, including the Apple Memory Guide and Service Parts Database, and links to other Apple online sites.

- Apple Tech Info Library (TIL) (http://til.info.apple.com/techinfo.nsf/) – Over 16,000 articles indexed by a powerful search engine, constantly updated, available over the Internet all day, every day.
- MacTest Pro diagnostic software (described later in this module) – Apple's own diagnostics for thoroughly testing PowerBook hardware and verifying operation.

  MacTest Pro diagnostic software is available by subscription to Authorized Apple Service Providers. Between subscription mailings, updates are available through the Service Source Online web site.

- Tech Exchange (http://support.info.apple.com/te/te.qry) – A one-stop shopping area for Apple product support information. In this area, information is gathered from several other web sites, including the TIL, software updates, discussion forums, and hot news. Moderated discussion boards allow customers and technicians to exchange information on product issues.

- Apple Service Guides (ASGs) for Macintosh Computers – Compact service manuals that include service information for most PowerBook computers.

  ASGs can be ordered through the Apple Service Price Pages.
- Owner’s manuals – A good source of information for model-specific setup procedures and specifications.

  Owner’s Manuals for most PowerBook computers are on the CD for this course, in pdf format.
- Software updates – Current Apple software updates are available online through several sites. You can access the software update sites through the TIL, Tech Exchange, or Service Source Online.
- Your own log of common problems – It is always a good idea to keep a log of problems you have encountered and solved and to refer to the log when you encounter similar problems.
- Customer records – By asking whether new hardware or software has recently been installed, and whether the computer has been repaired or upgraded before, you can gain important clues for troubleshooting and repair. Here are 10 basic questions to consider asking:
  - What is the symptom?
  - What was the customer doing when the problem occurred?
  - What is the exact system configuration? (Exact system hardware, Macintosh Operating System version, amount of memory (RAM), other software versions involved, network connectivity.)
  - Have you recently added or removed any software or hardware?
  - Are there any unusual environmental conditions?
  - In which application(s) does the problem occur?
  - Is this the first time this problem has happened?
  - Were there any other applications open or running when the problem occurred?
  - Have you installed any non-Apple extensions?
  - Do you have any peripherals attached to the system and have you changed anything about them recently?
- Apple Technical Support phone line – If all else fails, call the Apple Technical Support phone line for help (800 919-2775, option 3). You must have your Apple Authorized Service

Provider account number ready. (You can find your account number on Traveler, Service Repair Invoice, and Subscriptions envelopes.)

In the rest of this module, we will focus our attention on *Service Source* CD, the Tech Info Library (TIL), and MacTest Pro diagnostic software.

Exercise 1: Troubleshooting Process and Resources

Try to answer the following questions from memory. If you need assistance, review this section of this module.

1. List the missing steps in the PowerBook computers troubleshooting process.
    a. Gather information from the customer.
    b. ________________________________
    c. ________________________________
    d. Run appropriate diagnostic tests.
    e. ________________________________
    f. ________________________________
    g. ________________________________
2. List at least six Apple troubleshooting and repair resources.
    a. ________________________________
    b. ________________________________
    c. ________________________________
    d. ________________________________
    e. ________________________________
    f. ________________________________
3. Give two reasons for verifying the problem (duplicating the symptoms reported by the user) before you attempt a repair.
    a. ____________________________________
    ____
    b. ____________________________________
    ____

Note — When you are finished, compare your answers to those on the following page.

Exercise 1: Answers

Compare your answers with those given below.

1. List the missing steps in the troubleshooting process.
    - a. Gather information from the customer.
    - b. Verify the problem (duplicate the symptoms).
    - c. Try quick fixes.
    - d. Run appropriate diagnostic tests.
    - e. Use systematic fault isolation procedures, referring to Service Source or Apple Service Guides for product-specific guidance.
    - f. Use additional resources (such as the Tech Info Library) to research the problem.
    - g. Escalate if necessary to a technical assistance group.
2. List at least six Apple troubleshooting and repair resources. (You should have identified any six from the following list.)
    - Service Source Hardware Service Manuals
    - Service Parts Database
    - Apple Spec Database
    - Apple Memory Guide
    - Service Source Online
    - The TIL
    - MacTest Pro diagnostic software
    - Tech Exchange
    - Apple Service Guides for Macintosh Computers
    - Owner’s manuals
    - Software updates internet sites
    - Log of common problems
    - Customer Records
    - Apple Technical Support
3. Give two reasons for verifying the problem (duplicating the symptoms reported by the user) before you attempt a repair.
    - a. The reported problem may actually be a user error or misperception.

b. When you change the hardware or software configuration, you can introduce other problems. After changing the user’s system, you will never be able to verify that the original problem was really there.

Service Source CD

Service Source CD (SSCD) is Apple’s main reference tool for service technicians. You should be familiar with SSCD from the Macintosh Service and Tools Course. This section reviews some features of Service Source that you will find particularly useful when you troubleshoot PowerBook computers.

Hardware Service Manuals

The service manuals in *Service Source* CD provide detailed directions and symptom charts for troubleshooting each of Apple’s products. *Service Source* CD has a separate manual for each product or product group. Most of the PowerBook manuals have the following chapters:

- Hot Issues
- Basics
- Specifications
- Troubleshooting
- Take Apart
- Adjustments
- Upgrades
- Additional Procedures
- Exploded View

Hot Issues is a new feature of recent PowerBook hardware service manuals. It contains top service issues and the solutions that Apple has identified.

The Troubleshooting section of hardware service manuals includes Symptom Charts and Flow Charts designed for that product.

Troubleshooting Note — Before you use the Symptom Charts in Service Source, verify that the problem is not due to a software problem. Service Source Symptom Charts normally assume that you have already verified that the problem is not a software problem.

Service Parts Database

The Service Parts Database replaces the Parts Lists that used to be found within hardware service manuals. The Service Parts Database is an easily searchable FileMaker Pro database that allows you to find parts for any Apple product, with illustrations, part numbers, and other information.

Note — An Internet version of the Service Parts Database is available through Service Source Online.

Apple Spec Database

The Apple Spec Database is a new feature of *Service Source* CD that allows you to search for information about features and configurations of Apple products.

Apple Memory Guide

The Apple Memory Guide contains complete memory specifications for all Macintosh and PowerBook computers. To access the Memory Guide, click on the Hardware tab of the Service Source Startup window, and then click on the Memory side tab.

Troubleshooting Tab

In addition to product-specific hardware service manuals, Service Source has a general Troubleshooting tab (in the Service Source Startup window). The Troubleshooting tab includes the following side-tab sections:

- HW/SW Troubleshooting – includes the following articles related to PowerBook troubleshooting:
  - Troubleshooting Apple Products – an outline of the troubleshooting steps you should follow when you diagnose and repair Apple computers.
  - Software Troubleshooting – an overview of system software issues and techniques for solving software-related problems.
- Mac OS Updates – includes detailed instructions for installing specific system software versions
- Theories of Operation – includes theory of operation articles about Macintosh computers (including PowerBook computers), network servers, and Apple printers.

Service Source Hands-On Exercise

If you are unfamiliar with the PowerBook hardware service manuals, the Troubleshooting tab on Service Source, or the Service Parts Database, complete the following hands-on exercise:

1. Open one of the PowerBook hardware service manuals on Service Source.
2. Become familiar with the types of information presented in each of the chapters of the manual.
3. From the Service Source Startup window, click the Troubleshooting tab. Open and review the “Troubleshooting Apple Products” and “Software Troubleshooting” articles.
4. Open the Apple Memory Guide and find the DRAM configurations for the PowerBook 2300 Series computers.
5. Open the Service Parts Database (by clicking its icon on the *Service Source* CD window).
6. In the Service Parts Database, search for PowerBook parts that contain the word “inverter.”
7. When the list of parts appears, double-click on any item to see the kind of information that the Service Parts Database contains. (To return from any part to the list of parts, click the List View button at the bottom of the screen.)

Note — When you are finished, continue with this module.

The Tech Info Library (TIL)

The Tech Info Library (TIL) contains over 16,000 articles about Apple products. A public version of the TIL is available to users at http://til.info.apple.com. Apple Authorized Service Providers can access a version of the TIL that contains additional service-related information through Service Source Online.

The TIL contains valuable information about specific problems and late-breaking information on new products, as well as archived information about older and even obsolete products. Using the TIL's search capabilities, technicians can quickly find answers to questions about current and past Apple products.

Exercise 2: Using the TIL

The following exercise familiarizes you with some of the TIL's capabilities.

1. Access the TIL by logging on to http://til.info.apple.com with your web browser.
2. Search for articles using the following search string. Type it exactly as you see it here (including the quotation marks):

   "PowerBook", "battery"

   Print (or save a screen shot of) the window that contains the list of articles.
3. Return to the search window and search for articles using the following search string:

   PowerBook and battery

   Which of the two search strings yielded the best results?

   (For more information on TIL search techniques, click on the link to the TIL Help page.)
4. Use the search engine to find a TIL article that contains instructions for resetting the power manager on a PowerBook G3 Series computer.
5. Write down the number of the article you found and the procedure for resetting the power manager on a PowerBook G3 Series computer.

   TIL Article #:________________

   ____

   ____

   ____

   ____

   ____

   ____

Note — When you are finished, compare your answers to those on the following page.

Exercise 2: Answers

3. Return to the search window and search for articles using the following search string:

   PowerBook and battery

   Which of the two search strings yielded the best results?

   The second search string was more effective in that it yielded a list of articles ranked by relevance.

Note — For tips on composing search strings, see TIL article #22104.

---

5. Write down the number of the article you found and the procedure for resetting the power manager on a PowerBook G3 Series computer.

   You should have been able to find the following information about resetting the power manager:

   TIL Article: 28510

   To reset the power manager, hold down the Shift, Function, and Control keys and press the power key. To force a regular system reset without turning off the power, hold down the Control and Command keys and press the power key.

   After you reset the power manager Manager, wait for at least 5 seconds (longer is not necessary) before you power on the unit.

Note — There may be more than one TIL article that contains information about any given topic. The article you found may have a different number than the number given on this Answer page, but the information should be the same.

MacTest Pro Diagnostics for PowerBook Computers

MacTest Pro is your key diagnostic resource for Apple products. This section

- Alerts you to special tips you need to be aware of when you run MacTest Pro on PowerBook computers
- Describes the MacTest Pro modules for PowerBook computers

For a detailed module on MacTest Pro in general, see the *Macintosh Service and Tools Course*.

Tips for Using MacTest Pro

Please take note of the following tips when you run MacTest Pro diagnostic tests on a PowerBook computer:

- Use the AC adapter (not the battery) as the computer’s power source, so that the PowerBook does not shut down before the test finishes. Using the AC adapter is especially important when you run extended or looping tests.
- Set the PowerBook or Energy Saver control panel so that the computer will not go to sleep.
  - If the computer is running System 7.1.1 or later, move the Sleep slider to the “Never” position (see Figure 4-20 and Figure 4-26).
  - If the computer is running system software earlier than System 7.1.1, click the Options button on the PowerBook control panel and then select “Don’t sleep when plugged in” (see Figure 4-5).
- If possible, start up from the *MacTest Pro* CD. Booting from the CD ensures that the recommended set of extensions is used and that other MacTest Pro system requirements are met. Starting up from the CD also prevents unwanted interactions with the user’s customized system settings.
- If you boot from the hard disk and run MacTest Pro from the hard disk or from a floppy disk, follow these steps before you run the tests:

Note — These steps are not necessary if you boot from the *MacTest Pro* CD.

a. Turn AppleTalk off (in the Chooser).

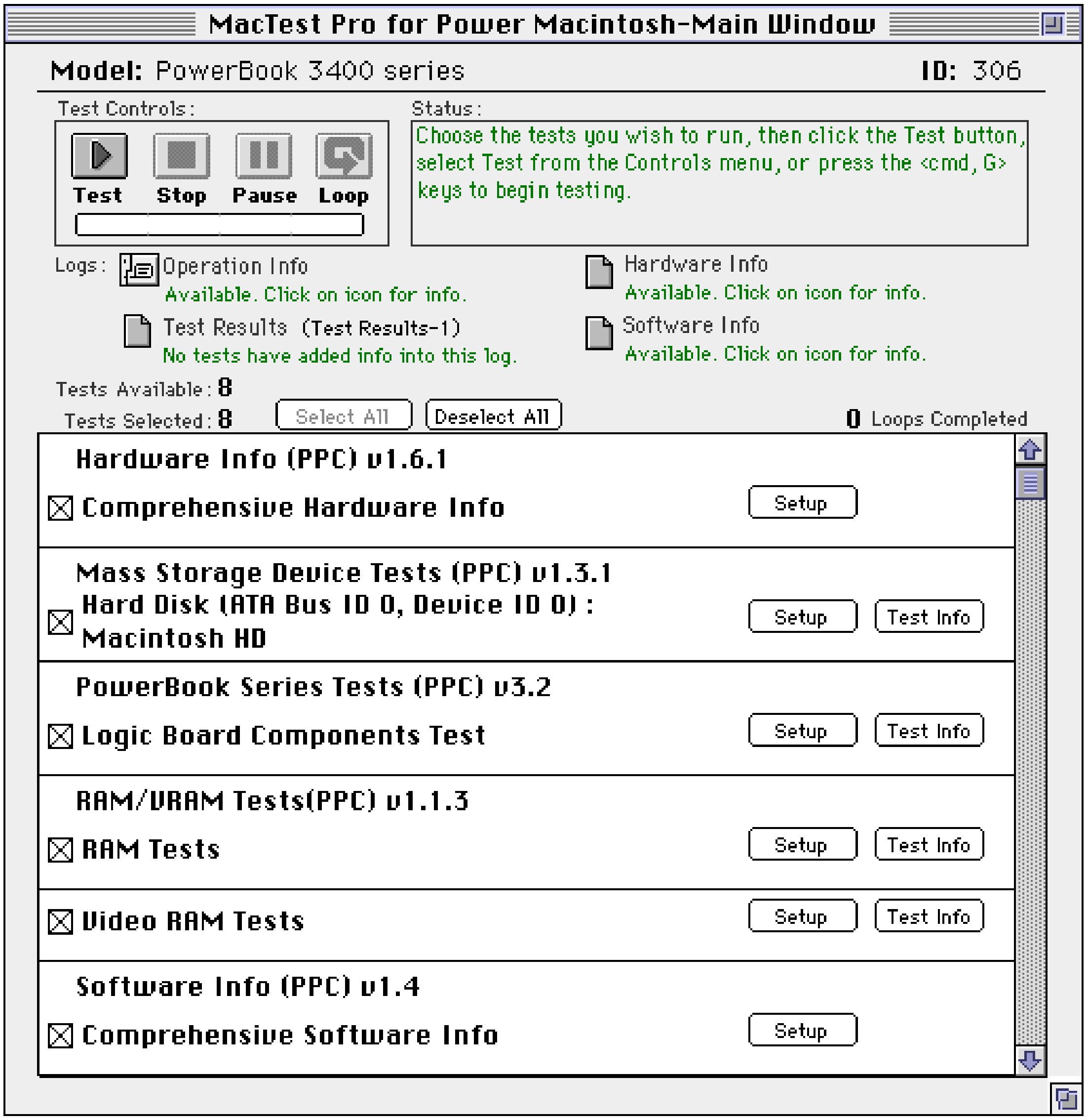
b. Turn Virtual Memory off (in the Memory control panel).

c. Choose the “base” extension set (in the Extensions Manager control panel). (If system software is earlier than System 7.5, turn extensions off as noted in the next step.)

d. Restart the computer. (If system software is earlier than System 7.5, disable the extensions by holding down the Shift key while you restart the computer.)

MacTest Pro Test Modules

Figure 5-1 shows the most important MacTest Pro test modules and utilities for PowerBook computers at the present time (May, 1998).



MacTest Pro for Power Macintosh-Main Window

Model: PowerBook 3400 series **ID:** 306

Status: Choose the tests you wish to run, then click the Test button, select Test from the Controls menu, or press the <cmd, G> keys to begin testing.

Logs:

Operation Info — Available. Click on icon for info.

Hardware Info — Available. Click on icon for info.

Test Results (Test Results-1) — No tests have added info into this log.

Software Info — Available. Click on icon for info.

Tests Available: 8

Tests Selected: 8

0 Loops Completed

Hardware Info (PPC) v1.6.1

☒ **Comprehensive Hardware Info**

Mass Storage Device Tests (PPC) v1.3.1

☒ **Hard Disk (ATA Bus ID 0, Device ID 0) : Macintosh HD**

PowerBook Series Tests (PPC) v3.2

☒ **Logic Board Components Test**

RAM/VRAM Tests(PPC) v1.1.3

☒ **RAM Tests**

☒ **Video RAM Tests**

Software Info (PPC) v1.4

☒ **Comprehensive Software Info**

Figure 5-1: MacTest Pro Main Window

PowerBook Series Tests

The PowerBook Series Tests is a special test module for the logic board components of PowerBook computers. For the PowerBook G3 Series, the following tests are included:

- Sound Controller
- PRAM
- Floppy Controller
- Battery (if installed)
- SCC
- VIA1
- Power Manager
- IR (infrared)
- Modem Card

Note — Not all the tests listed above are available for all PowerBook computers, and the PowerBook Series Tests may include different tests for other PowerBook models. The particular tests available depend on the PowerBook model being tested.

RAM/VRAM Test

The RAM / VRAM test module allows you to thoroughly check the RAM and video RAM, including RAM expansion cards.

File Checker or System Software Tests

File Checker and System Software Tests are two versions of essentially the same test. In MacTest Pro for 680x0-based computers, the test is called *File Checker*; in MacTest Pro for PowerPC-based computers, the test is called *System Software Tests.*

For 680x0 PowerBook computers, File Checker does an extensive directory, resource, and system file check of all mounted local HFS (hierarchical filing system, the classic Macintosh format for hard drives and floppy drives) volumes of the computer you are testing.

For PowerPC-based PowerBook computers, System Software Tests includes directory, resource, and system file checks of HFS volumes. For HFS Plus volumes (a disk format option available with Mac OS 8.1 or later), System Software Tests includes resource and system file checks; to check the directory structure of an HFS

Plus volume, you must use Disk First Aid version 8.1 or later (you cannot use MacTest Pro). You can launch Disk First Aid from the Special menu of MacTest Pro.

Hardware Info

The Hardware Info test module collects and displays information about the computer and attached peripherals, including the amount of RAM and ROM, the type of processor, and the available storage devices.

Software Info

The Software Info test module collects and displays information about the software installed on the startup volume, including the version of System and Finder, system enablers, and any control panels and extensions.

Mass Storage Device and CD/DVD/DAT Tests

In MacTest Pro for 680x0-based computers, the Mass Storage Device Tests module tests all Apple CD-ROM drives, hard drives, and tape drives attached to the computer under test.

In MacTest Pro for Power PC-based computers, the Mass Storage Device Tests module tests only hard drives and Zip drives. CD, DVD, and DAT drives computers are tested by the CD / DVD / DAT Tests module.

Display Service Utility

Display Service Utility (DSU) is a separate application available on the *MacTest Pro* CD. DSU generates display test patterns that you can use to visually test PowerBook displays.

For More Information

Review the *MacTest Pro User’s Guide*, in the Documentation folder on the *MacTest Pro* CD, for more information on the use of MacTest Pro diagnostics.

Note — There are two versions of the *MacTest Pro User’s Guide*, one for MacTest Pro for 680x0 computers and another for MacTest Pro for PowerPC-based computers. Be sure to refer to the version that applies to the computer you are testing.

Exercise 3: MacTest Pro

If you have never used MacTest Pro on a PowerBook computer, please complete the following exercise before you continue with this module.

Note — For the PowerBook 100 computer, only MTP Emergency is available, not the full MacTest Pro application. If you are using a PowerBook 100 computer for this exercise, run the MTP Emergency application.

---

1. If a CD-ROM drive is not available, copy the MacTest Pro program to the hard drive in your PowerBook computer from the *MacTest Pro for Power Macintosh Application and Modules Disk (PowerBooks), v 1.0* diskette. (You can make the diskette from a disk image on the CD. You will need a Macintosh computer with a CD-ROM drive and a floppy drive to make the diskette.)
2. If a CD-ROM drive is available, start up the computer from the *MacTest Pro* CD. Otherwise, start up from the hard disk.
3. Launch MacTest Pro.
4. Review the available tests.
5. Run the MacTest Pro tests on your PowerBook.
6. Review the test log after the tests are completed.
7. Briefly describe the following MacTest Pro modules for PowerBook computers:
   a. PowerBook Series Tests

   ____

   ____

   b. RAM / VRAM Tests

   ____

   ____

   c. File Checker / System Software Tests

   ____

   ____

   d. Hardware Info

   ____

e. Software Info

f. Mass Storage Devices Tests/CD/DVD/DAT Tests

8. What is the purpose of the Display Service Utility?

Note — When you are finished, compare your answers to those on the following page.

Exercise 3: Answers

7. Briefly describe the following MacTest Pro modules for PowerBook computers:

    a. PowerBook Series Tests – Test logic board components. The particular tests available depend on the PowerBook model being tested.

    b. RAM/VRAM Tests – Test any installed RAM and Video RAM, including RAM expansion cards.

    c. File Checker/System Software Tests – For 680x0 PowerBook computers, File Checker does an extensive directory, resource, and system file check of all mounted local HFS volumes of the computer you are testing.

    d. For PowerPC-based PowerBook computers, System Software Tests includes directory, resource, and system file checks of HFS volumes. For HFS Plus volumes (a disk format option available with System 8.1 or later), System Software Tests includes resource and system file checks; to check the directory structure of an HFS Plus volume, you must use Disk First Aid version 8.1 or later.

    e. Hardware Info – Gathers information about the computer and attached peripherals, including the amount of RAM and ROM, the type of processor, and the available storage devices.

    f. Software Info – Gathers information about the software installed on the startup volume, including the version of System and Finder, system enablers, and any control panels and extensions.

    g. Mass Storage Devices Tests/CD/DVD/DAT Tests – In MacTest Pro for 680x0-based computers, the Mass Storage Device Tests module tests all Apple CD-ROM drives, hard drives, and tape drives attached to the computer under test.

    h. In MacTest Pro for Power PC-based computers, the Mass Storage Device Tests module tests only hard drives and Zip drives. CD, DVD, and DAT drives computers are tested by the CD/DVD/DAT Tests.

8. What is the purpose of the Display Service Utility?

    DSU generates display test patterns that you can use to visually test PowerBook displays.

Repairing PowerBook Computers 6

This module reviews procedures and resources used to repair PowerBook computers.

What You Will Learn

When you finish this module, you will be able to identify the special tools and resources that you need when you repair PowerBook computers. You will also be able to describe the procedures needed for PowerBook repair (including resetting PRAM, resetting the power manager, and after-repair procedures) and the special precautions you should take when you make these repairs.

The Skills Checklist following this introduction lists, in detail, the tasks that you should be able to perform after completing this module.

Required Materials and Equipment

This module requires the following materials and equipment:

- Service Source (April 1998 or later)
- Macintosh computer capable of running *Service Source* CD (for hardware platform requirements, see the *Service Source* CD booklet)

Time to Complete This Module

This module should take approximately 45 minutes to complete.

Skills Checklist

If you think you already possess the following skills, go directly to the test exercises. If you pass the exercises, congratulations! You're done! If you don't pass the exercises, complete this module before you proceed.

_______ • Identify and briefly describe six cautions to observe when you service PowerBook computers.

_______ • Identify what a power manager reset does, and what problems it solves.

_______ • Identify where to find instructions for parameter RAM (PRAM) reset and power manager reset for any PowerBook computer.

_______ • Identify how to reset the parameter RAM (PRAM) of a specified PowerBook model.

_______ • Identify how to reset the power manager unit (PMU) of a specified PowerBook model.

_______ • Identify the procedures for servicing a built-to-order PowerBook computer.

_______ • Identify the follow-up procedures that Apple recommends after you repair a PowerBook computer.

Cautions to Observe in PowerBook Repair

The portability of a PowerBook computer is a result of lightweight materials and compact design. For a PowerBook computer to contain most of the elements of a desktop computer, as well as several more, its components must be greatly reduced in size. This compact design results in smaller, more fragile ribbon cables, connectors, tabs and latches, and components more sensitive to ESD damage. In addition, to minimize weight, most of the PowerBook casing is made from various types of plastic.

Each of these design elements means that you must bring a heightened level of care and attention to PowerBook repairs. To minimize the risk of damage, you may want to use a nylon flathead screwdriver to separate plastics and to lift components when you repair PowerBook computers.

Ribbon Cables

Many of the components you learned about in Module 2 of this course are connected to each other by very fragile, thin ribbon cables. These cables are easily torn, creased and/or cracked if not handled in a deliberate and cautious manner. Ribbon cables are often wrapped around and/or threaded through parts in a specific path. When you remove a cable, carefully note the cable's path, so that you can reinstall it in exactly the same way.

Cable Connectors

Like the cables they connect, cable connectors are fragile and can be broken easily. When a connector is broken, the component or part containing the connector must be replaced. Some PowerBook connectors are not keyed, making it possible to install the connector backwards. Carelessly forcing or improperly connecting a cable can also short-out other components. When repairing PowerBook computers, avoid costly errors by taking time to carefully and accurately attach each connector.

Tabs and Latches

Many components and parts are connected to each other with plastic tabs and latches. Like the cables and connectors, the tabs and latches are very thin and fragile. If you breaking a latch or tab, you may have to replace the entire part, which can be very costly. When you take apart a PowerBook computer, be sure to use the appropriate tools, such as a jewellers' screwdriver or nylon flathead screwdriver, to carefully release tabs and latches and to avoid scratching the plastics.

Screws

There are two important cautions about screws in PowerBook repairs:

- Use the proper screws.
- Avoid overtorquing when you replace screws.

Remember that most of the PowerBook case is made of plastic. Unless specified otherwise in a PowerBook models service manual, screws should be tightened to 1.5-2.0 foot-pounds. If you use the wrong screws or overtighten the screws when you replace them, you could warp or break the plastics or strip the threads in the insertion hole.

To avoid causing this kind of damage, keep track of the screws you remove, replace them in their proper positions, and tighten them just until they are comfortably tight, no tighter.

Electrostatic Discharge (ESD)

Although you must take proper ESD precautions whenever you service an Apple computer, you must take special care to protect the CMOS devices in PowerBook computers. CMOS devices are even more susceptible to ESD damage than components found in desktop computers. Before you service PowerBook computers, ensure that all ESD precautions are fully implemented.

If your repair shop is not equipped to meet the special needs of repairing PowerBook computers, you can send the computer to Apple Computer for repair. Call 800 919-2775 and select the “schedule a repair” option. You must have your service provider ID number.

Of course, before you attempt any repair, verify the problem first. See the Troubleshooting module of this course and the *Macintosh Operating System Troubleshooting* v 1.0 course for further details.

Note — When you are ready, complete Exercise 1 on the following page.

Exercise 1: Cautions

Identify and briefly describe the six cautions to observe when you repair PowerBook computers. Try to respond from memory. If you need assistance, review this section of this module.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

Note — When you are finished, compare your answers to those on the following page.

Exercise 1: Answers

Compare your answers to the exercise with those given below.

Identify and briefly describe the six cautions to observe when you repair PowerBook computers. (Your answers do not need to be stated exactly as those listed below).

1. Ribbon cables – Handle PowerBook cables in a deliberate and cautious manner, so as not to tear, crease, or crack them. When you remove a cable, carefully note the cable's path so that you can reinstall it in the exact same path.
2. Cable connectors – Don't force connectors. When a connector is broken, the component or part containing the connector must be replaced. Some PowerBook connectors are not keyed, making it possible to install the connector backwards. Carelessly forcing or improperly connecting a cable can short the component.
3. Tabs and latches – Breaking a latch or tab often requires replacing the entire part, which can be very costly. When you take apart a PowerBook computer, be sure to use the appropriate tools, such as a jewelers' screwdriver, to carefully release tabs and latches.
4. Screws – Use the proper screws. (Keep track of the screws you remove, and replace them in the same location.)
5. Screws – Don't overtighten screws, lest you warp or crack the plastics or strip the insertion holes.
6. ESD – Although you must take ESD precautions whenever you service an Apple computer, you must take special care to protect the CMOS devices in PowerBook computers. CMOS devices are even more susceptible to ESD damage than components found in desktop computers. Before you service PowerBook computers, ensure that all ESD precautions are fully implemented.

Resetting the Power Manager and PRAM

In this section, you will learn about, and practice, resetting the power manager and parameter RAM.

Power Manager Reset

Resetting the power manager unit (PMU) can be useful if the computer is displaying power-related problems, such as not powering on at all or restarting spontaneously after a shutdown. These problems can be caused by corruption in the code contained in the power manager unit's RAM. The remedy is to reload a fresh copy of the PMU code from ROM into the PMU's RAM. This is what a power manager reset does.

Corruptions in the power manager code are typically caused by power surges. Plugging in the PowerBook computer improperly can also corrupt the power manager code. The AC adapter should always be connected to a live AC outlet before the adapter is plugged into or removed from the PowerBook computer.

If both the main and backup batteries are low on power, the PMU code can become corrupt as well.

Parameter RAM Reset

Parameter RAM (PRAM) contains user-definable system and hardware preferences. Occasionally these preferences become corrupt and the PRAM needs to be reset, or “zapped.”

Resetting PRAM restores the default settings in most control panels. Before you reset a the PRAM, be sure to note the settings of network-related control panels. If the computer is using Open Transport, you can do this by exporting the AppleTalk and TCP/IP settings. If the computer is not using Open Transport, take screen shots of the settings in these control panels.

After you reset the PRAM, import the AppleTalk and TCP/IP settings (or reset them from the screen shots) and set the time zone, date, and time correctly. On some PowerBook computers with passive-matrix displays, you may also need to adjust the contrast.

Where to Find Reset Information

Different PowerBook models require different techniques for resetting the power manager unit. For instance, on the PowerBook 500 series, you have to remove the AC adapter and the battery for 3-5 minutes, and then hold down the Control, Command, Option, and power keys for 5-10 seconds before you reconnect power. On the PowerBook 1400 series, you shut down the computer, and then restart it by holding down the reset button for 10 to 20 seconds.

To find the proper techniques for resetting the power manager and PRAM, check one or more of these sources:

- *Service Source* CD – PRAM and power manager reset instructions for released PowerBook computers can usually be found in the product manuals on *Service Source* CD. The procedures are usually located in the Additional Procedures section or (in some models) in the Troubleshooting section. To find the procedures quickly, you can use the Find function to search for “reset.”
- Service Source Online – If a new PowerBook model has been released but the *Service Source* CD that documents it has not yet come out, the Service Source manual for that model will be posted on Service Source Online (http://service.info.apple.com/).
- The Tech Info Library (TIL) – Use the search feature of the TIL (http://til.info.apple.com/techinfo.nsf/) to find the article you need. For instance, if you are looking for PowerBook power manager reset procedures, type the following search string:

  “PowerBook” and “power manager” and “reset”

  And then click the Search button. The first few articles found will usually contain the information you are looking for.

Since hands-on is the best way to learn, your next task is to find and perform these reset procedures for the PowerBook computer you have been working with during this course.

Exercise 2: PRAM and Power Manager Resets

1. To practice resetting PRAM, follow these steps:
   a. Note the network-related control panel settings. See Parameter RAM Reset earlier in this module.)
   b. Locate the PRAM reset instructions for the PowerBook model you are working with. Use *Service Source* CD, the TIL, or Service Source Online to find the information.
   c. Reset the PRAM of your PowerBook computer.
   d. Import or reset the network-related control panel settings.
   e. Set the time zone, date and time.
2. To practice resetting the power manager, follow these steps:
   a. Locate the power manager reset instructions for the PowerBook model you are working with. Use *Service Source* CD, the TIL, or Service Source Online to find the information.
   b. Reset the power manager of your PowerBook computer.
3. It is January 1999 and a new PowerBook computer has just been released. The last *Service Source* CD you have is dated December 1998. Where can you find the Service Source manual for the new computer?

   ____

4. Which section of the *Service Source* CD PowerBook 190/5300 manual contains PRAM and power manager reset procedures?
   a. Basics
   b. Specifications
   c. Troubleshooting
   d. Additional Procedures
5. Which section of the *Service Source* CD PowerBook 140 manual contains power manager reset procedures?
   a. Basics
   b. Specifications
   c. Troubleshooting

   d. Additional Procedures

6. What problems would cause you to consider resetting a PowerBook computer's power manager? (Choose all that apply.)

   a. Computer will not start up.

   b. Computer starts up spontaneously after shutdown.

   c. Computer screen dims after one minute.

   d. The user has installed a new battery.

Note — When you are finished, compare your answers to those on the following page.

Exercise 2: Answers

3. It is January 1999 and a new PowerBook computer has just been released. The last *Service Source* CD you have is dated December 1998. Where can you find the Service Source manual for the new computer?

   Service Source Online

4. Which section of the *Service Source* CD PowerBook 190/5300 manual contains PRAM and power manager reset procedures?

   d. Additional Procedures

5. Which section of the *Service Source* CD PowerBook 140 manual contains power manager reset procedures?

   c. Troubleshooting

6. What problems would cause you to consider resetting a PowerBook computer's power manager? (Choose all that apply.)

   a. Computer will not start up.

   b. Computer starts up spontaneously after shutdown.

Servicing Built-to-Order PowerBook Computers

The PowerBook G3 Series of computers can be ordered in many configurations. To ensure that the computer you return to the user has the same configuration as the computer you received, do the following:

1. Create an Apple System Profiler report with system overview, network/communication, and device information before you attempt any repairs.
2. Check Hot Issues on Service Source Online for news that my impact repair. (see, for example, “PowerBook G3 Series: HFS Plus Is Not Compatible with Norton Utilities v. 3.5”).
3. Troubleshoot and repair the PowerBook computer, according to the instructions in this course, in the Macintosh Operating System Troubleshooting 1.0 course, and in the Apple Service Guides.
4. Verify that the repaired computer is configured correctly, checking against the Apple System Profiler report you created in step 1.

After Repairing a PowerBook Computer

The following tips for post-repair procedures will help you ensure that the customer is satisfied with your work.

Power Up Using the AC Adapter

When a PowerBook computer has been disassembled and reassembled, its components have been without power for some time. This loss of power causes the PRAM and the PMU RAM to lose their contents. When the computer is first powered on after a disassembly, the power manager will attempt to reload its code from ROM.

Using the power adapter as the power source ensures that the power manager unit is properly reset. If you power on using the battery, there may not be enough voltage to effectively reset the power manager unit.

Therefore, after you repair a PowerBook computer, always follow these steps:

1. Plug the power adapter into a known-good AC power source.
2. Plug the power adapter into the computer.
3. Power on the computer.

Run MacTest Pro Diagnostics

Run MacTest Pro diagnostics to verify that the repair is complete. If the unit passes all applicable MacTest Pro tests, you can be sure that the computer is fully functional and ready to be returned to the user.

Test: Repair Skills

Try to answer these questions from memory. If you cannot answer them from memory, refer to this module, or to the service manual for the appropriate PowerBook model.

1. There are specific cautions to observe when repairing PowerBook computers, above and beyond normal cautions of repairing computers.

   a. True.

   b. False.

2. Try resetting the power manager when you see the following symptom(s): (Check all that apply.)

   a. The display dims after a low-power warning.

   b. The computer restarts spontaneously after shut down.

   c. The hard disk attempts to spin up repeatedly.

   d. The computer will not power on when connected to known-good power.

   e. The computer refuses to enter sleep mode.

3. A power manager reset does the following:

   a. Zaps PRAM.

   b. Puts a fresh copy of PMU code in PMU RAM.

   c. Flushes PMU code from ROM.

   d. Puts a fresh copy of the PowerBook control panel on disk.

4. Apple recommends that you follow these procedures after you repair a PowerBook computer: (Check all that apply.)

   a. None, after the repair your work is done.

   b. Power up using the AC adapter.

   c. Rebuild the desktop with extensions off.

   d. Run MacTest Pro diagnostics.

   e. Check for viruses.

5. Which of the following iteme represent areas where you need to take special caution when you repair PowerBook computers? (Check all that apply.)
    a. Ribbon cables.
    b. Cleaning chemicals.
    c. ESD.
    d. Temperature.
    e. Cable connectors.
    f. Torque.
    g. Light exposure.
    h. Tabs and latches.
    i. Screws.
6. To find how to reset the power manager for the PowerBook model you are working on, look in the following sources: (Check all that apply.)
    a. The Product area of the Apple web page.
    b. *Service Source* CD.
    c. The Tech Info Library (TIL).
    d. Send email to service@apple.com with “PMU Reset PBxxx” in the subject.
    e. AppleFacts Online.
    f. Service Source Online.
7. How do you reset PRAM on a PowerBook G3 Series computer?
    a. Press Command-Control-Escape on restart.
    b. Shut down, press the reset button for 10-20 seconds.
    c. Press Command-Option-p-r on restart.
    d. Press Shift-Fn-Control-power.

8. Which of the following are among the steps you need to take to reset the PMU on a PowerBook 520c? (Check all that apply.)
   - a. Press Command-Option-p-r on restart.
   - b. Remove all power for 3-5 minutes.
   - c. Press Control-Command-Option-power for 5-10 seconds.
   - d. Boot from Disk Tools 1, pressing Command-Escape.
   - e. Shut down, press the reset button for 10-20 seconds.
9. A power manager reset zaps PRAM.
   - a. True.
   - b. False.
10. Different PowerBook models require you follow different steps to reset the power manager.
   - a. True.
   - b. False.

Note — When you are finished, compare your answers to those on the following page.

Test: Answers

1. There are specific cautions to observe when repairing PowerBook computers, above and beyond normal cautions of repairing computers.

   a. True.

2. Try a power manager reset when you see the following symptom: (Check all that apply.)

   b. The computer restarts spontaneously after shut down.

   d. The computer will not power on when connected to known-good power.

3. A power manager reset does the following:

   b. Puts a fresh copy of PMU code in PMU RAM.

4. Apple recommends following these procedures after repairing a PowerBook computer: (Check all that apply.)

   b. Power up using the AC adapter.

   d. Run MacTest Pro diagnostics.

5. Which of the following represent areas of special caution when repairing PowerBook computers? (Check all that apply.)

   a. Ribbon cables.

   c. ESD.

   e. Cable connectors.

   f. Torque.

   h. Tabs and latches.

   i. Screws.

6. To find how to reset the power manager for the PowerBook model you are working on, look in the following sources: (Check all that apply.)

   b. *Service Source* CD

   c. The Technical Information Library (TIL).

   f. Service Source Online.

7. How do you reset PRAM on a PowerBook G3 Series computer?

   d. Press Shift-Fn-Control-power.

8. Which of the following are among the steps you need to take to reset the PMU on a PowerBook 520c? (Check all that apply.)

   b. Remove all power for 3-5 minutes.

   c. Press Control-Command-Option-power for 5-10 seconds.

9. A power manager reset zaps PRAM.

   b. False.

10. Different PowerBook models require you follow different steps to reset the power manager.

    a. True.